BNP-B3977A (ENG)

MITSUBISHI CNC

MELDAS MDS-B Series

Linear Servo System

Specifications and Instruction Manual

ADVANCED AND EVER ADVANCING
MITSUBISHI ELECTRIC

Introduction

Thank you for purchasing the Mitsubishi linear servo system.
This instruction manual describes the handling and caution points for using this CNC.
Incorrect handling may lead to unforeseen accidents, so always read this instruction manual thoroughly to ensure correct usage.
Make sure that this instruction manual is delivered to the end user.

Precautions for safety

Please read this instruction manual and auxiliary documents before starting installation, operation, maintenance or inspection to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation.

The safety precautions in this instruction manual are ranked as "DANGER" and "CAUTION".

DANGER	When a dangerous situation may occur if handling is mistaken leading to fatal or major injuries.
CAUTION	When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

Note that some items described as **CAUTION** may lead to major results depending on the situation. In any case, important information that must be observed is described.

The signs indicating prohibited and mandatory items are described below.

	This sign indicates that the item is prohibited (must not be carried out). For example,  is used to indicate "Fire Prohibited".
	This sign indicates that the item is mandatory (must be carried out). For example,  is used to indicate grounding.

After reading this instruction manual, keep it in a safe place for future reference.

In this instruction manual, the cautions on a level that will not lead to physical damage and the cautions for special functions, etc., are ranked as "NOTICE", "INFORMATION" and "MEMO".

NOTICE : When a fault in the product will occur but physical damage will not occur if handling is mistaken.

INFORMATION : When special functions will be started with parameter changes, or when there are other usage methods.

MEMO : Information that should be known for operation.

For Safe Use

1. Special precautions for linear servo system

DANGER

The linear servo system uses a powerful magnet on the secondary side. Thus, caution must be taken not only by the person installing the linear motor, but also the machine operators. For example, persons wearing a pacemaker, etc., must not approach the machine.

The person installing the linear motor and the machine operator must not have any items (watch or calculator, etc.) which could malfunction or break due to the magnetic force on their body.

Always use nonmagnetic tools for installing the linear motor or during work in the vicinity of the linear motor.
(Example of nonmagnetic tool)
Explosion-proof beryllium copper alloy safety tool: Nihon Gaishi

2. Electric shock prevention

DANGER

Do not open the front cover while the power is ON or during operation. Failure to observe this could lead to electric shocks.

Do not operate the machine with the front cover removed. The high voltage terminals and charged sections will be exposed, and may pose a risk of electric shocks.

Do not remove the surface cover even when the power is OFF unless carrying out wiring work or periodic inspections. The inside of the servo amplifier is charged, and may pose a risk of electric shocks.

Wait at least 10 minutes after turning the power OFF, before starting wiring or inspections. Failure to observe this could lead to electric shocks.

Ground the servo amplifier and linear servomotor with Class 3 grounding or higher.

Wiring and inspection work must be done by a qualified technician.

Wire the servo amplifier and linear servomotor after installation. Failure to observe this could lead to electric shocks.

Do not touch the switches with wet hands. Failure to observe this could lead to electric shocks.

Do not damage, apply forcible stress, place heavy items or engage the cable. Failure to observe this could lead to electric shocks.

3. Fire prevention

CAUTION
Install the servo amplifier, linear servomotor and regenerative resistor on noncombustible material. Direct installation on combustible material or near combustible materials could lead to fires.
If a servo amplifier fault should occur, turn OFF the power on the servo amplifier's power supply side. If a large current continues to pass, fires could occur.
Shut off the power with the error signal. Failure to do so could cause the regenerative resistor to abnormally overheat and fires to occur due to faults in the regenerative transistor, etc.

4. Injury prevention

CAUTION
Do not apply a voltage other than that specified in Instruction Manual on each terminal. Failure to observe this item could lead to ruptures or damage, etc.
Do not mistake the terminal connections. Failure to observe this item could lead to ruptures or damage, etc.
Do not mistake the polarity(+, -) . Failure to observe this item could lead to ruptures or damage, etc.
Do not touch the servo amplifier fins, regenerative resistor or linear motor, etc., while the power is turned ON or immediately after turning the power OFF. Some parts are heated to high temperatures, and touching these could lead to burns.

5. Various precautions

Observe the following precautions. Incorrect handling of the unit could lead to faults, injuries and electric shocks, etc.

(1) Transportation and installation

⚠ CAUTION

- Correctly transport the product according to its weight.
- Do not stack the products above the tolerable number.
- Do not hold the front cover when transporting the servo amplifier. The unit could drop.
- Follow this Instruction Manual and install the unit in a place where the weight can be borne.
- Always store the secondary side of the linear servomotor in the delivered packaged state.
- Do not get on top of or place heavy objects on the unit.
- Always observe the installation directions.
- During the interval from unpacking to installation, the risks posed by the magnetic attraction force in the secondary side of the linear servomotor will increase, so take special care, and install the correctly.
- Secure the specified distance between the servo amplifier and control panel, or between the servo amplifier and other devices.
- Do not install or run a servo amplifier or linear servomotor that is damaged or missing parts.
- Do not let conductive objects such as screws or metal chips, etc., or combustible materials such as oil enter the servo amplifier or linear servomotor.
- The servo amplifier and linear servomotor are precision devices, so do not drop them or apply strong impacts to them.
- Store and use the units under the following environment conditions.

Environment	Conditions			
	Servo amplifier	**Scale I/F unit**	**Pole detec-tion unit**	**Linear servomotor**
Ambient temperature	0°C to +55°C (with no dew condensation)			0°C to +40°C (with no dew condensation)
Ambient humidity	90% (RH) or less (with no dew condensation)			80% (RH) or less (with no dew condensation)
Storage temperature	–15°C to +70°C (with no freezing)			–15°C to +50°C (with no freezing)
Storage humidity	90% (RH) or less (with no dew condensation)			
Atmosphere	Indoors (Where unit is not subject to direct sunlight) With no corrosive gas, combustible gas, oil mist or dust.			
Altitude	1000m or less above sea level			
Vibration	4.9m/s^2	98m/s^2		98m/s^2

⚠ CAUTION
⚠ Always use nonmagnetic tools when installing the linear servomotor.
⚠ Always mount a mechanical stopper on the end of the linear servomotor's travel path to avoid danger if the motor should go over the end.
⚠ Securely fix the linear servomotor onto the machine. Insufficient fixing could cause the servomotor to come off during operation.
⚠ Provide a cover on the movable sections of the linear servomotor so that they are never touched during operation.
❗ When storing for a long time, please contact your dealer.

(2) Wiring

⚠ CAUTION
⚠ Correctly and securely perform the wiring. Failure to do so could lead to runaway of the servomotor.
⚠ Do not install a phase advancing capacity, surge absorber or radio noise filter on the output side of the servo amplifier.
⚠ Correctly connect the output side (terminals U, V, W). Failure to do so could lead to abnormal operation of the servomotor.
⚠ Do not directly connect a commercial power supply to the linear servomotor. Doing so could lead to faults.
⚠ Make sure not to mistake the orientation of the surge absorbing diode installed on the DC relay for the control output signal. Failure to do so could cause a trouble preventing the signal from being output, or could inhibit operation of the protection circuit during an emergency stop, etc.
⚠ Do not connect/disconnect the cables connected between each unit while the power is ON.
⚠ Securely tighten the fixing screws and fixing mechanisms on the cable connectors. Insufficient fixing could cause the connectors to dislocate during operation.
⚠ Ground the shield cables indicated in the Connection Manual with a cable clamp, etc.
⚠ Separate the signal wire away from the power line/electricity line.
⚠ Use wires and cables having a wire diameter, heat resistance and bending characteristics compatible for the system.

(3) Trial operation and adjustment

⚠ CAUTION
⚠ Check and adjust each parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine.
⚠ Do not make remarkable adjustments and changes as the operation could become unstable.

(4) Usage methods

⚠ CAUTION
⚠ Install an external emergency stop circuit so that the operation can be stopped and power shut OFF immediately.
⚠ Unqualified persons must not disassemble or repair the unit.
⚠ If the alarm is reset (RST) with the operation start signal (ST) ON, the servomotor will restart suddenly. Confirm that the operation signal is OFF before resetting. Failure to observe this could lead to accidents.
⚠ Never make modifications.
⚠ Reduce magnetic interference by installing a noise filter. The electronic devices used near the servo amplifier could be affected by magnetic noise.
⚠ Always use the linear servomotor and servo amplifier with the designated combination.
⚠ The linear servomotor basically does not have any devices such as the magnetic brakes installed. Thus, when using this for an axis onto which an unbalance force is applied, such as a gravity axis, install a stopping device on the machine side to secure safety.
⚠ Always carry out trial operation after changing the program or parameters, and after maintenance and inspection.
⚠ Do not enter the machine's movable range during automatic operation.
⚠ For an unbalanced axis, such as a gravity axis, basically balance it with a device such as a counterbalance. With the linear motor, the continuous thrust is lower than the rotary motor, so if the axis is unbalanced the motor's heating amount will increase. If an error should occur, the axis will drop naturally. This is hazardous as the dropping distance and dropping speed are large.

(5) Troubleshooting

⚠ CAUTION
⚠ If a hazardous situation is predicted during stop or product trouble, install an external brake mechanism.
⚠ If an alarm occurs, remove the cause and secure the safety before resetting the alarm.
⚠ Never go near the machine after restoring the power after a failure, as the machine could start suddenly. (Design the machine so that personal safety can be ensured even if the machine starts suddenly.)

(6) Maintenance, inspection and part replacement

⚠ CAUTION
⚠ Carry out maintenance and inspection after backing up the servo amplifier programs and parameters.
⚠ The capacity of the electrolytic capacitor will drop due to deterioration. To prevent secondary damage due to failures, replacing this part every five years when used under a normal environment is recommended. Contact the Service Center or Service Station for replacements.
⚠ Do not carry out a megger test (insulation resistance test) during the inspections.
⚠ If the battery warning is issued, save the machining program, tool data and parameters with an input/output device, and then replace the battery.

(7) Disposal

⚠ CAUTION
⚠ Treat this unit as general industrial waste. Note that the MDS Series units with a heat radiating fin protruding from the back use alternate Freon, and thus cannot be treated as general industrial waste. Always return this part to the Service Center or Service Station. A permanent magnet is used on the secondary side of the linear servomotor. This also must be returned to the Service Center or Service Station.
⚠ Do not disassemble the servo amplifier or linear servomotor parts.

(8) General precautions

⚠ CAUTION
The drawings given in this Specifications and Maintenance Instruction Manual show the covers and safety partitions, etc., removed to provide a clearer explanation. Always return the covers or partitions to their respective places before starting operation, and always follow the instructions given in this manual.

Contents

Chapter 1 Outline

1-1 Outline

In recent years, demands for high accuracy, high speed and high efficiency have increased in the field of machine tools. The application of a linear servo for the feed axis has increased as a measure to respond to the demands.
With the linear servo system, high speed and high acceleration characteristics can be achieved in respect to the ball screw drive system. Furthermore, as there is no ball wear, etc., which is the disadvantage of using a ball screw drive, the life of the machine can be extended. A response error caused by backlash or wear does not occur, so a high accuracy system can be structured.
The MELDAS linear servo system has been developed to realize a max. speed of 120m/min and acceleration of 98m/s^2 (motor unit) as a standard.

1-2 Features

(1) Ample lineup (Seven models)

Machines can be handled flexiblely. Thus, thrust can be increased by using several motors for one axis.

(2) High speed and high acceleration

The max. speed is 2m/s as a standard. An acceleration of 98m/s^2 is possible with the motor unit.

(3) Absolute position detection system

As the absolute position detection system, the Mitsutoyo linear scale AT342 and Heidenhain absolute position linear scale LC191M are compatible with the MELDAS high-speed serial communication specifications. (Both are battery-less)

(4) High performance servo drive

Compared to the conventional amplifier MDS-B-Vx, the servo processing performance has been greatly improved. The high-gain servo MDS-B-V14L has been developed to achieve high speed and more accurate machining in combination with the high frequency PWM control. Linear servo systems requiring a higher speed and accuracy are powerfully backed up by the high-gain servo MDS-B-V14L.

Chapter 2 Drive System Configuration

⚠ WARNING

⚠ All wiring work must be carried out by a qualified electrician.

⚠ Wait at least 10 minutes after turning the power OFF, before starting wiring or inspections. Failure to observe this could lead to electric shocks.

⚠ Install the servo amplifier and linear servomotor before staring wiring. Failure to observe this could lead to electric shocks.

⚠ Do not damage, apply forcible stress, place heavy things on, or catch the cables. Failure to observe this could lead to electric shocks.

⚠ CAUTION

⚠ Correctly wire the machine. Failure to observe this could lead to runaway of the linear servomotor or injuries.

⚠ Make sure not to mistake the connection terminals. Failure to observe this could lead to ruptures or trouble.

⚠ Make sure not to mistake the polarity (+, –). Failure to observe this could lead to ruptures or trouble.

⚠ Make sure not to mistake the orientation of the surge absorbing diode installed on the DC relay for the control output signal. Failure to do so could cause a trouble preventing the signal from being output, or could inhibit operation of the protection circuit during an emergency stop, etc.

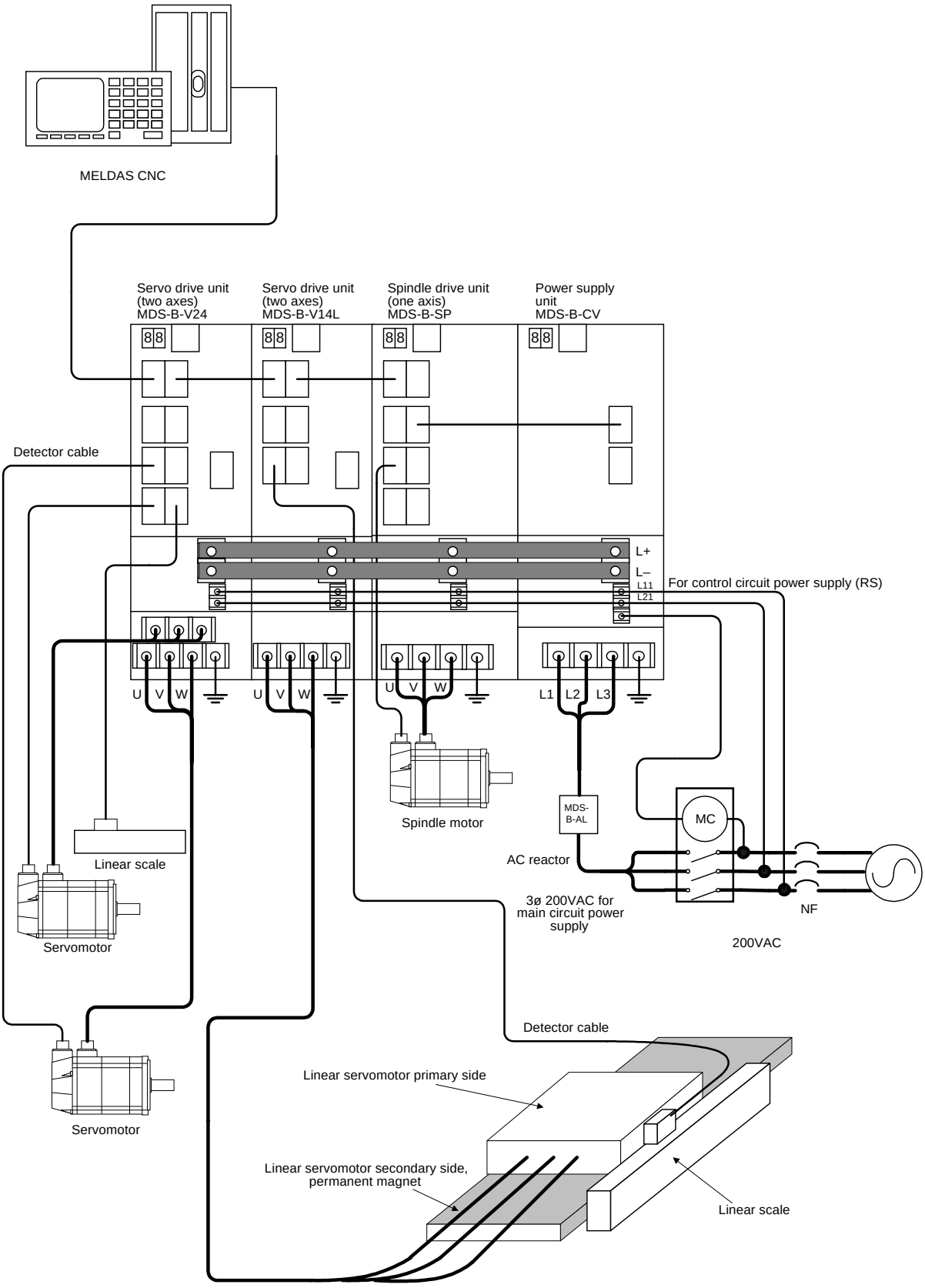
⚠ Do not install a phase-advancing capacitor, surge absorber or radio noise filter on the output side of the servo amplifier.

⚠ Shut off the power with the error signal. Failure to do so could cause the regenerative resistor to abnormally overheat and fires to occur due to faults in the regenerative transistor, etc.

⚠ Do not modify the machine.

2.1 Basic system configuration

Example: One spindle axis + two rotary servo axes + one linear servo axis

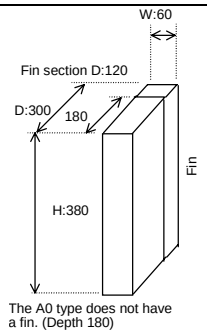
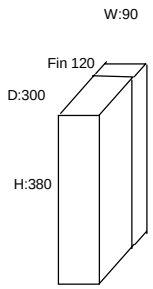
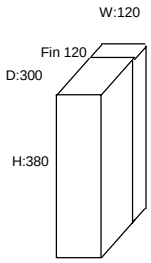
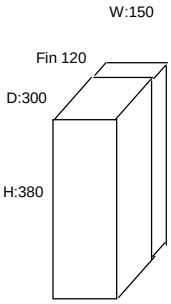


⚠ CAUTION

1. In a system having a spindle drive unit, always place the spindle drive unit next to the power supply unit as shown in the drawing. Also, place the servo drive unit 11kW and above next to the power supply unit.
2. When also using a spindle drive unit, place the units next to the power supply unit in order of the drive capacity size.
3. The use of the contactor installation can be selected except for the MDS-B-CV-370.
4. Use without a contactor is possible, except for the MDS-B-CV-370. However, for safety purposes, use of a contactor is recommended. Set the rotary switch on the power supply unit as follows according to whether the contactor is used.
   With contactor ・・・・・・ Rotary switch setting = 0
   Without contactor ・・・ Rotary switch setting = 1
   For the MDS-A-CR, the rotary switch is fixed to 0. Always install a contactor.
5. Always install an AC reactor (shipped from Mitsubishi). Note that this is not required for the A-CR. Wire the AC reactor to the front (NF side) of the contactor.

2-2 List of units and corresponding linear motors

Linear servo amplifier			Corresponding servo amplifier (LM-□)							
Type MDS-B-	Capacity	Outline H×W×D (mm) Outline dimension types	Type	NP2S-05M	NP2M-10M	NP2L-15M	NP4S-10M	NP4M-20M	NP4L-30M	NP4G-40M
			Max. thrust	1500N	3000N	4500N	3000N	6000N	9000N	12000N
V14L-01	0.1kW	380×60×180 A0 type								
V14L-03	0.3kW									
V14L-05	0.5kW									
V14L-10	1.0kW									
V14L-20	2.0kW	380×60×300 A1 type		■						
V14L-35	3.5kW				■		■			
V14L-45	4.5kW	380×90×300 B1 type				■		■		
V14L-70	7.0kW	380×120×300 C1 type								
V14L-90	9.0kW								■	
V14L-110	11.0kW	380×150×300 D1 type								■
V14L-150	15.0kW									

Outline dimension and outline type of each unit	A0/A1	B1	C1	D1
Outline drawing (mm)				

2-3 Linear motor drive system

⚠ CAUTION

1. With the linear servo system, the linear motor is assembled into the machine, and the position detector (linear scale) is also installed when the machine is assembled. Thus, it is not possible to know the motor pole position beforehand as information in the CNC unit. At the first machine startup, basically, the servo loop cannot be applied, so take special care when starting up a machine having an unbalanced axis such as a gravity axis.

⚠ CAUTION

2. The linear servomotor basically does not have any devices such as the magnetic brakes installed. Thus, when using this for an axis onto which an unbalance force is applied, such as a gravity axis, install a stopping device on the machine side to secure safety.

⚠ CAUTION

3. Use the linear servomotor and servo amplifier with the designated combination.
   For an unbalanced axis, such as a gravity axis, basically balance it with a device such as a counterbalance. With the linear motor, the continuous thrust is lower than the rotary motor, so if the axis is unbalanced the motor's heating amount will increase. If an error should occur, the axis will drop naturally. This is hazardous as the dropping distance and dropping speed are large.

2-3-1 Standard linear servo system

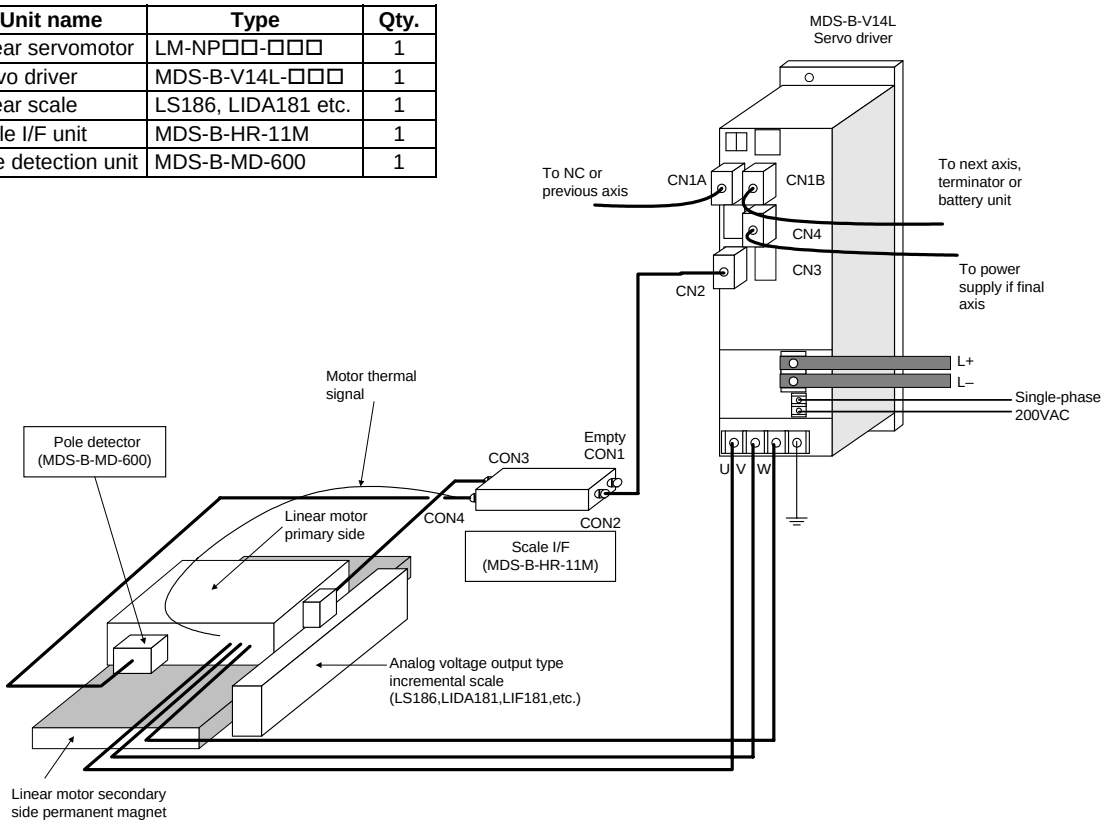
The standard drive system configuration of the linear servo system is shown below. For the linear servo system, the corresponding servo drive unit is the MDS-B-V14L.

Detection system	Resolution	Max. speed	Servo driver	Linear scale	Scale I/F	Pole detection unit	Remarks
Incre-mental system	0.04µm	120m/min	MDS-B-V14L-□□□	LS186 (Heidenhain)	MDS-B-HR11M	MDS-B-MD-600	Standard incremental system
	0.08µm	480m/min Note currently this is 120m/min due to restrictions by the linear motor.		LIDA181 (Heidenhain)			High-speed operation is possible. However, as the scale is an open type, there are limits to the working environment.
	0.008µm	48m/min		LIF181 (Heidenhain)			This has a high resolution so the controllability is increased. The max. speed is limited. (Open type scale)
	With the above three types, an analog voltage output type scale can also be used.						
Absolute system	0.1µm	120m/min	MDS-B-V14L-□□□	LC191M (Heidenhain)	—	—	Standard absolute system.
	0.5m	110m/min		AT342 (Mitsutoyo)	—	—	
	Absolute position 0.5µm Position/ speed resolution for control 0.04µm	110m/min		AT342 special (Mitsutoyo	MDS-B-H		This has a high resolution so the controllability is increased. (The control position and speed resolution are increased.)

MDS-B-HR-21 can be used when detecting the motor thermal signal with the CNC.

(1) Standard incremental system

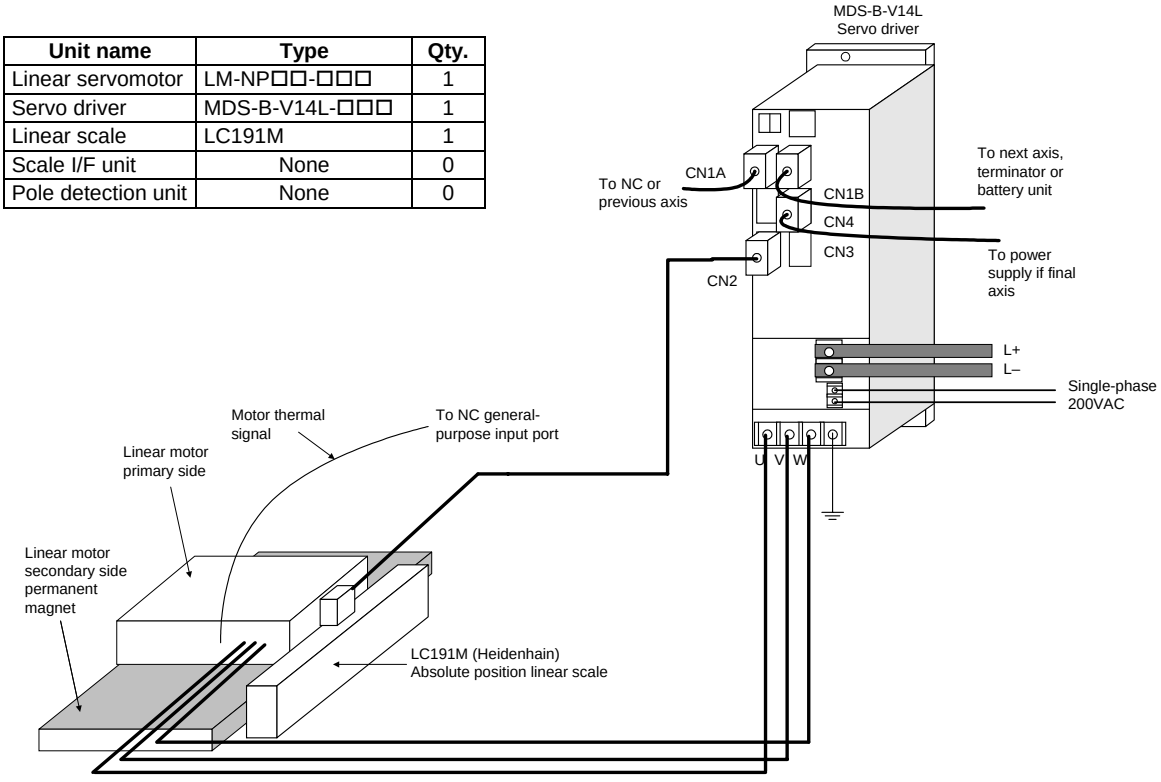
Unit name	Type	Qty.
Linear servomotor	LM-NP□□-□□□	1
Servo driver	MDS-B-V14L-□□□	1
Linear scale	LS186, LIDA181 etc.	1
Scale I/F unit	MDS-B-HR-11M	1
Pole detection unit	MDS-B-MD-600	1



(2) Absolute system (System using linear scale LC191M)

> **⚠ CAUTION** In a system that does not use the MDS-B-HR unit (scale I/F unit), use the motor thermal signal for the CNC unit's general-purpose input port, and detect the motor overheating.

Unit name	Type	Qty.
Linear servomotor	LM-NP□□-□□□	1
Servo driver	MDS-B-V14L-□□□	1
Linear scale	LC191M	1
Scale I/F unit	None	0
Pole detection unit	None	0

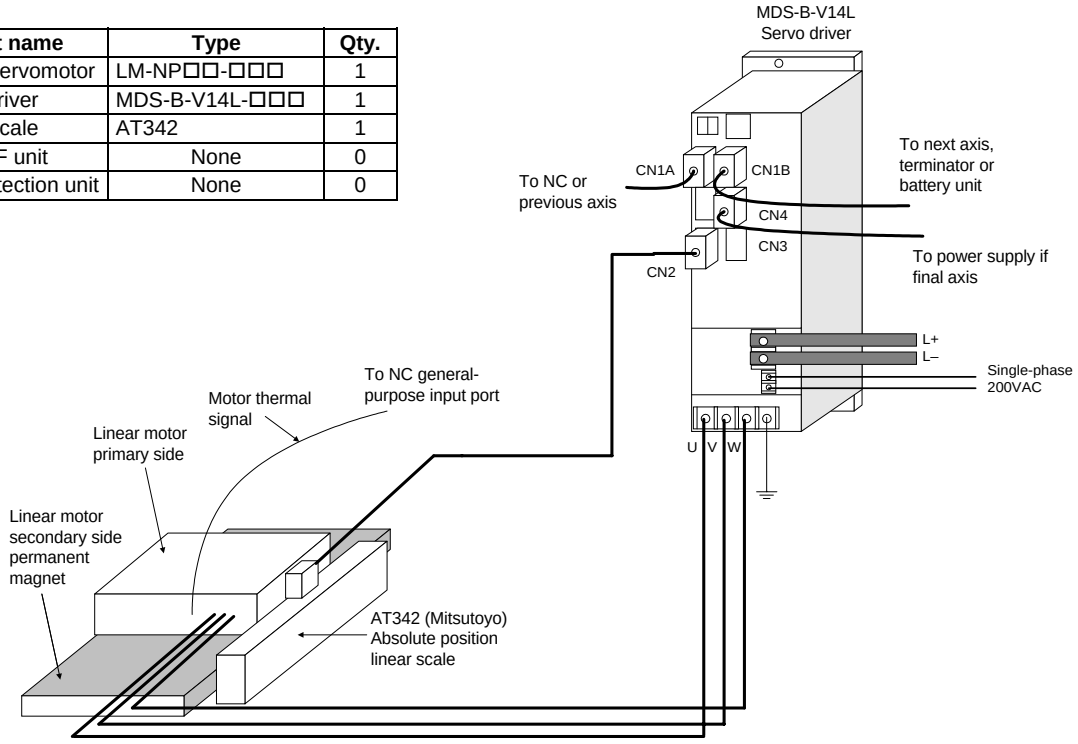


(3) Absolute system 2 (System using linear scale AT342)

The linear scale and servo drive unit can be connected directly and used without the scale I/F unit (MDS-B-HR) or pole detection unit (MDS-B-MD). Note that the position and speed resolution will be limited to 0.5µm, so to further improve the controllability, use of the system shown in (4) is recommended.

> **⚠ CAUTION** In a system that does not use the MDS-B-HR unit (scale I/F unit), use the motor thermal signal for the CNC unit's general-purpose input port, and detect the motor overheating.

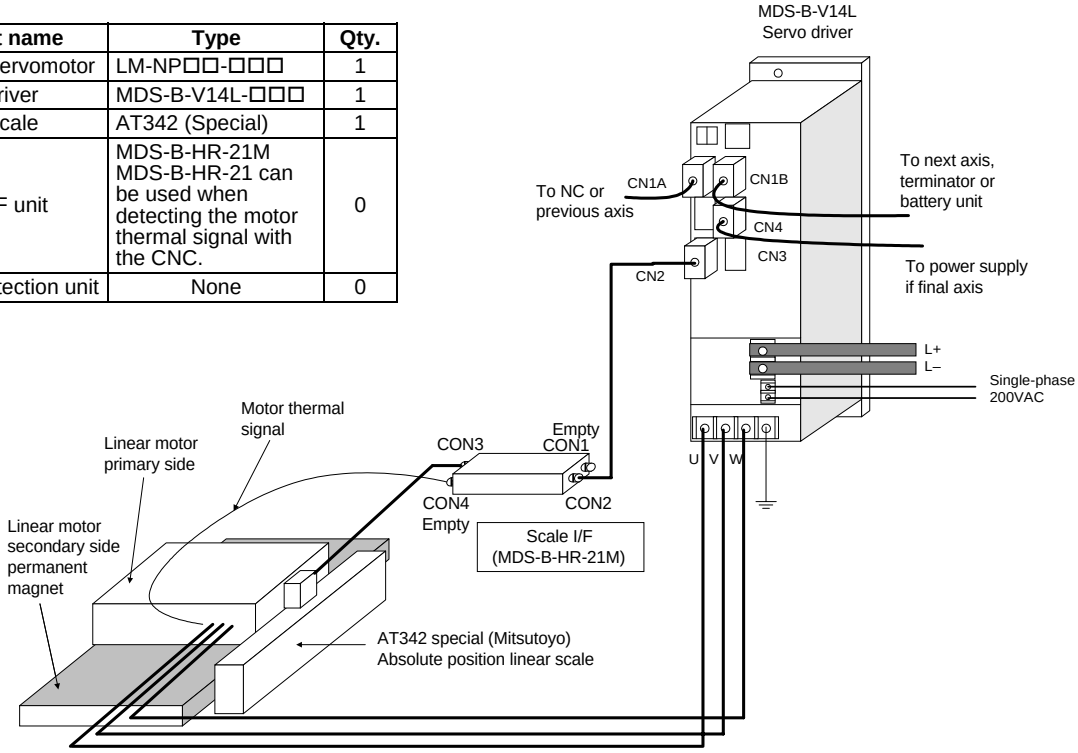
Unit name	Type	Qty.
Linear servomotor	LM-NP□□-□□□	1
Servo driver	MDS-B-V14L-□□□	1
Linear scale	AT342	1
Scale I/F unit	None	0
Pole detection unit	None	0



(4) Absolute system 3 (System using linear scale AT342 special + MDS-B-HR-21)

By using the scale I/F unit (MDS-B-HR), the resolution of the position and speed used for servo control can be improved, thereby improving the servo's controllability.

Unit name	Type	Qty.
Linear servomotor	LM-NP□□-□□□	1
Servo driver	MDS-B-V14L-□□□	1
Linear scale	AT342 (Special)	1
Scale I/F unit	MDS-B-HR-21M MDS-B-HR-21 can be used when detecting the motor thermal signal with the CNC.	0
Pole detection unit	None	0



2-3-2 Configuration of parallel drive system

The system configuration when driving one axis with two motors and two servo drive units is as shown below. In this case, the position command sent to each servo drive unit must be the same position command using the CNC synchronous control function.

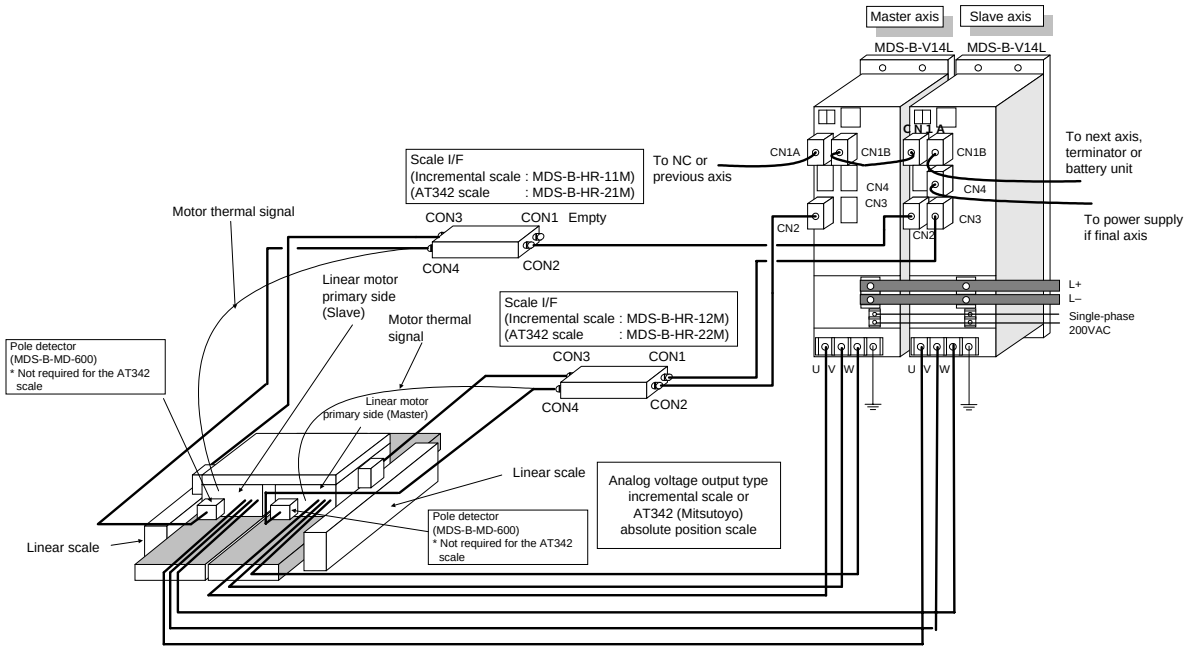
(1) 2-scale 2-motor (2-amplifier) control

Incremental system

Unit name	Type	Qty.
Linear servomotor	LM-NP□□-□□□	2
Servo driver	MDS-B-V14L-□□□	2
Linear scale	LS186, LIDA181 etc.	2
Scale I/F unit	MDS-B-HR-12M	1
	MDS-B-HR-11M	1
Pole detection unit	MDS-B-MD-600	2

Absolute system

Unit name	Type	Qty.
Linear servomotor	LM-NP□□-□□□	2
Servo driver	MDS-B-V14L-□□□	2
Linear scale	AT342 (Special)	2
Scale I/F unit	MDS-B-HR-22M MDS-B-HR-22 can be used when detecting the motor thermal signal with the NC.	1
	MDS-B-HR-21M MDS-B-HR-21 can be used when detecting the motor thermal signal with the NC.	1
Pole detection unit	None	0



(2) 1-scale 2-motor (2-amplifier) control

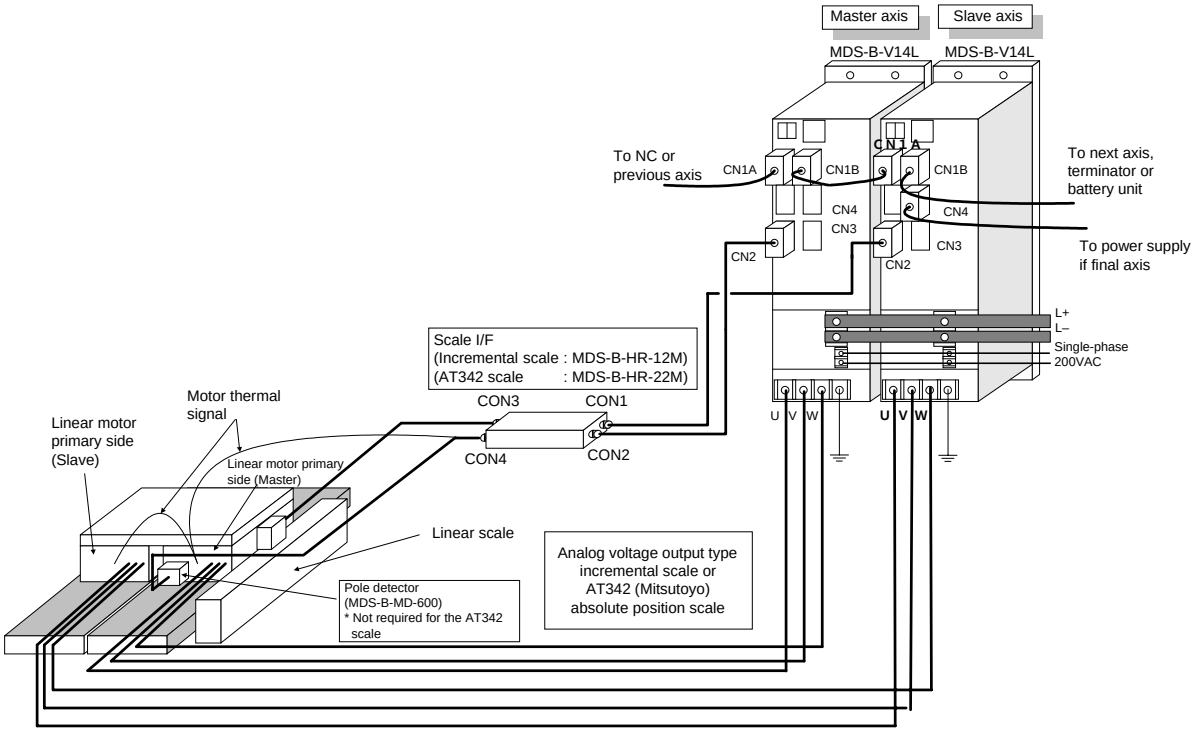
When using only one linear scale to detect the position, if this linear scale is an incremental scale, the pole position of each motor cannot be detected independently. Thus, the motor installation position on the master side and slave side must be mechanically aligned.
If the linear scale is an absolute position scale, the pole position of each motor can be set independently in the CNC as an absolute position even when only one linear scale is being used. However in this case, DC excitation must be carried out with only one motor, so this method is limited to when the axis can be driven with one motor (possible if low-speed drive) is possible.

Incremental system

Unit name	Type	Qty.
Linear servomotor	LM-NP□□-□□□	2
Servo driver	MDS-B-V14L-□□□	2
Linear scale	LS186, LIDA181 etc.	1
Scale I/F unit	MDS-B-HR-12M	1
Pole detection unit	MDS-B-MD-600	1

Absolute system

Unit name	Type	Qty.
Linear servomotor	LM-NP□□-□□□	2
Servo driver	MDS-B-V14L-□□□	2
Linear scale	AT342 (Special)	1
Scale I/F unit	MDS-B-HR-22M MDS-B-HR-22 can be used when detecting the motor thermal signal with the NC.	1
Pole detection unit	None	0



Chapter 3 Selection

3-1 Selecting the linear servomotor

It is important to select a linear servomotor matched to the purpose of the machine that will be installed. If the linear servomotor and machine to be installed do not match, the motor performance cannot be fully realized, and it will also be difficult to adjust the parameters. Be sure to understand the linear servomotor characteristics in this chapter to select the correct motor.

3-1-1 Max. feedrate

The max. feedrate for the LM-N Series linear servomotor is 120m/min. However, there are systems that cannot reach the max. speed 120m/min depending on the linear scale being used. Refer to the section "2-3-1 Standard linear servo system) for the main systems and possible max. feedrates.

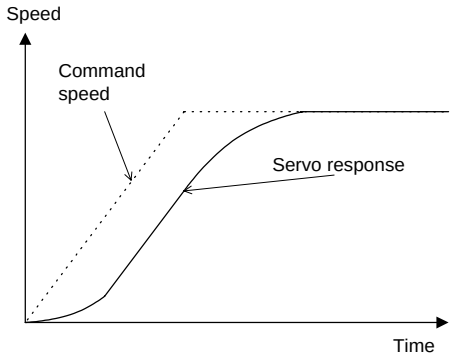
3-1-2 Max. thrust

The linear servomotor has an output range for the continuous thrust that can be used only for short times such as acceleration/deceleration. If the motor is a self-cooling type, a thrust that is approx. 6-fold can be output. For an oil-type motor, a thrust that is approx. 3-fold can be output.
The max. linear motor thrust required for acceleration/deceleration can be approximated using the machine specifications and expression (3-1).

$$Fmax = (M \bullet a + Ff) \bullet 1.2 \quad \cdots (3\text{-}1)$$

Fmax	: Max. motor thrust	(N)
M	: Movable mass (including motor's moving sections)	(kg)
a	: Acceleration during acceleration/deceleration	(m/s^2)
Ff	: Load force (including cutting force, wear and unbalance force)	(N)

Note that there is a servo response delay as shown on the right in respect to the acceleration in the acceleration/ deceleration command set with the CNC. Thus, the acceleration characteristics (thrust characteristics required for acceleration/deceleration when movable mass is applied) in respect to the speed required for the linear servomotor will be as shown on the next page. (Conditions: Indicates the characteristics using the position loop gain during SHG control using a linear acceleration/deceleration command pattern.) Thus, when selecting the linear motor, refer to the speed - acceleration (thrust) characteristics on the next page, and confirm the speed - thrust characteristics (4-4 Torque characteristics drawing) for the linear motor.

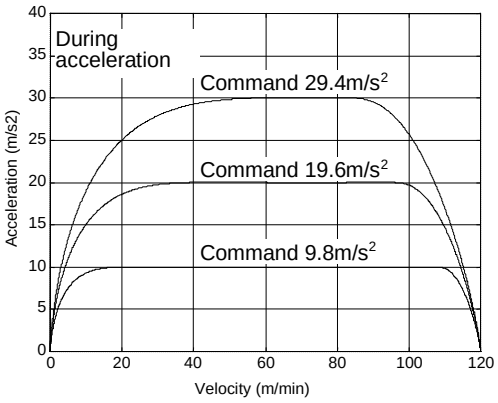


(Note) The speed – acceleration characteristics on the next page are reference values at a specific condition, so if an S-character acceleration/deceleration filter is applied on the command, if the position loop gain differs, the characteristics will also differ.

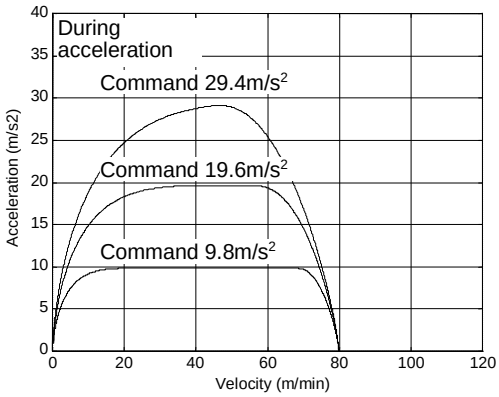
During acceleration: Speed – acceleration acceleration

Servo response characteristics

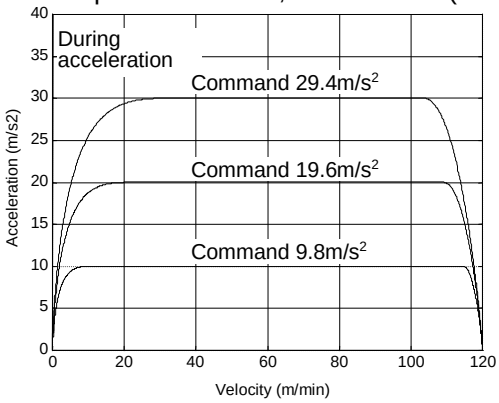
Max. speed 120m/min, PGN1 = 47 (SHG)



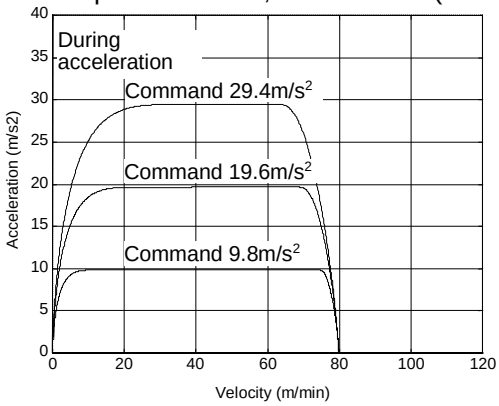
Max. speed 80m/min, PGN1 = 47 (SHG)



Max. speed 120m/min, PGN1 = 100 (SHG)



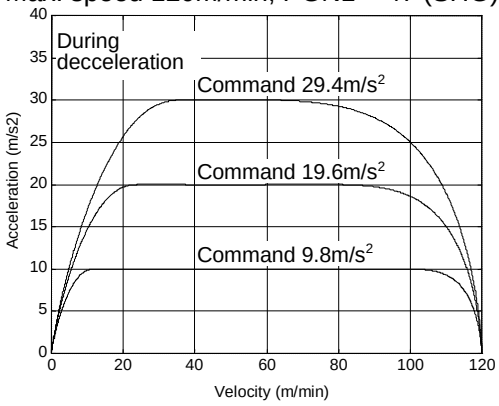
Max. speed 80m/min, PGN1 = 100 (SHG)



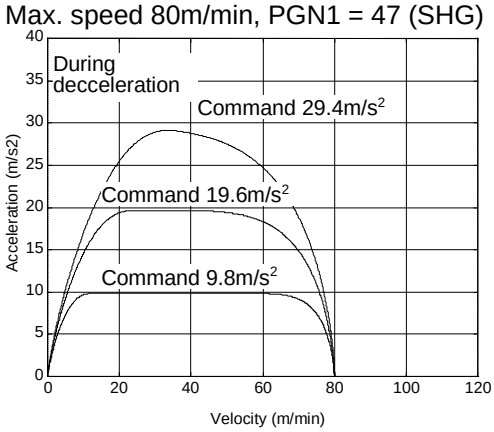
During deceleration: Speed –

Servo response characteristics

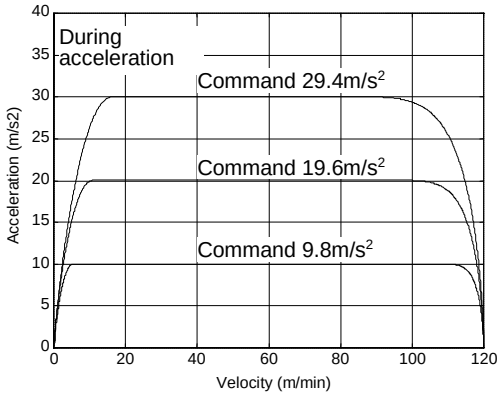
Max. speed 120m/min, PGN1 = 47 (SHG)



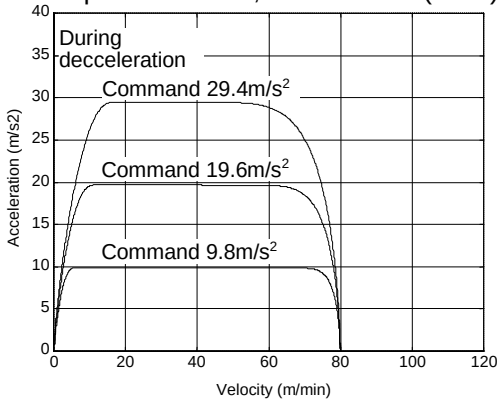
Max. speed 80m/min, PGN1 = 47 (SHG)



Max. speed 120m/min, PGN1 = 100 (SHG)



Max. speed 80m/min, PGN1 = 100 (SHG)



3-1-3 Continuous thrust

A typical operation pattern is assumed, and the motor's continuous effective load thrust (Frms) is calculated from the load force. If numbers (1) to (8) in the following drawing were considered a one cycle operation pattern, the continuous effective load thrust is obtained from the root mean square of the thrust during each operation, as shown in the expression (3-2).

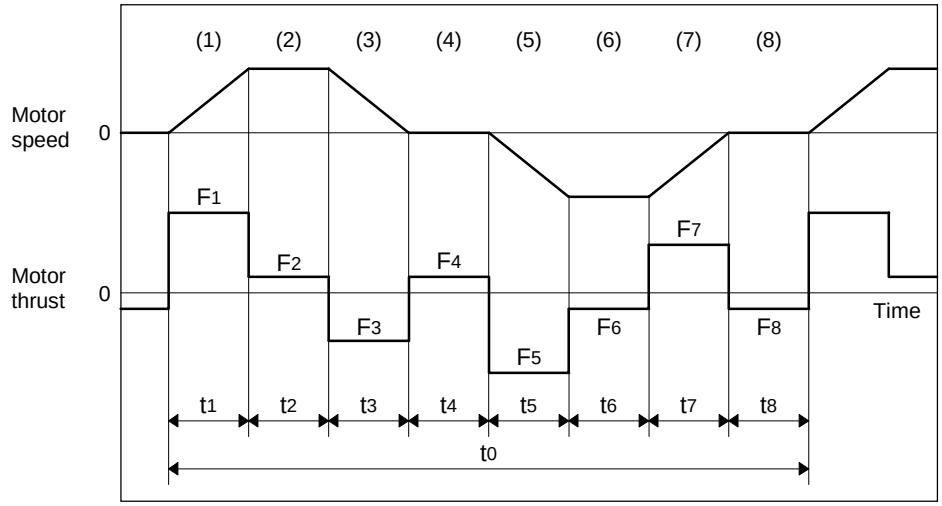


Fig. 3-1 Continuous operation pattern

$$Frms = \sqrt{\frac{F1^2 \cdot t1 + F2^2 \cdot t2 + F3^2 \cdot t3 + F4^2 \cdot t4 + F5^2 \cdot t5 + F6^2 \cdot t6 + F7^2 \cdot t7 + F8^2 \cdot t8}{t0}} \quad \cdots (3\text{-}2)$$

Select a motor so that the continuous effective load thrust (Frms) is 80% or less of the motor rated thrust (Fs).

$$Frms \leq 0.8 \times Fs \quad \cdots (3\text{-}3)$$

(1) Horizontal axis load thrust

When operations (1) to (8) are for a horizontal axis, calculate so that the following thrusts are required in each period.

Table 3-1 Load thrusts of horizontal axes

Period	Load thrust calculation method	Explanation
(1)	(Amount of acceleration thrust) + (Kinetic friction force)	Normally the acceleration/deceleration time constant is calculated so this thrust is 80% of the maximum thrust of the motor.
(2)	(Kinetic friction force) + (Cutting force)	
(3)	(Amount of deceleration thrust) + (Kinetic friction force)	The signs for the amount of acceleration thrust and amount of deceleration thrust are reversed when the absolute value is the same value.
(4)	(Static friction force)	Calculate so that the static friction force is always required during a stop.
(5)	– (Amount of acceleration thrust) – (Kinetic friction force)	The signs are reversed with period (1) when the kinetic friction does not change according to movement direction.
(6)	– (Kinetic friction force) – (Cutting force)	The signs are reversed with period (2) when the kinetic friction does not change according to movement direction.
(7)	– (Amount of deceleration thrust) – (Kinetic friction force)	The signs are reversed with period (3) when the kinetic friction does not change according to movement direction.
(8)	– (Static friction force)	Calculate so that the static friction force is always required during a stop.

(2) Unbalance axis load force

When operations (1) to (8) are for an unbalance axis, calculate so that the following forces are required in each period. Note that the forward speed shall be an upward movement.

Table 3-2 Load thrusts of unbalance axes

Period	Load thrust calculation method	Explanation
(1)	(Amount of acceleration thrust) + (Kinetic friction force) + (Unbalance force)	Normally the acceleration/deceleration time constant is calculated so this thrust is 80% of the maximum thrust of the motor.
(2)	(Kinetic friction force) + (Unbalance force) + (Cutting force)	
(3)	(Amount of deceleration thrust) + (Kinetic friction force) + (Unbalance thrust)	The signs for the amount of acceleration thrust and amount of deceleration thrust are reversed when the absolute value is the same value.
(4)	(Static friction force) + (Unbalance force)	The holding force during a stop becomes fairly large. (Upward stop)
(5)	– (Amount of acceleration thrust) – (Kinetic friction force) + (Unbalance force)	
(6)	– (Kinetic friction force) + (Unbalance force) – (Cutting force)	The generated force may be in the reverse of the movement direction, depending on the size of the unbalance force.
(7)	– (Amount of deceleration thrust) – (Kinetic friction force) + (Unbalance force)	
(8)	– (Static friction force) + (Unbalance force)	The holding force becomes smaller than the upward stop. (Downward stop)

POINT

During a stop, the static friction force may constantly be applied. The static friction force and unbalance force may particularly become larger during an unbalance upward stop, and the thrust during a stop may become extremely large. Therefore, caution is advised.

(3) Max. cutting thrust and max. cutting duty

If the max. cutting force and max. cutting duty (%/min) are known, the following expression can be used for the selection conditions.

$$0.8 \times Fs \geq Fc \times \sqrt{\frac{D}{100}} \quad \cdots (3\text{-}4)$$

Fs : Motor continuous thrust (N)
Fc : Max. cutting force during operation (N)
D : Max. cutting duty (%/min)

(4) Unbalance force

⚠ CAUTION

For an unbalanced axis, such as a gravity axis, basically balance it with a device such as a counterbalance. With the linear motor, the continuous thrust is lower than the rotary motor, so if the axis is unbalanced the motor's heating amount will increase. If an error should occur, the axis will drop naturally. This is hazardous as the dropping distance and dropping speed are large.

3-2 Selecting the power supply unit

Compared to the normal rotary motor, when using the linear servo system, the instantaneous output, such as the acceleration/deceleration, is large in respect to the continuous operation. Furthermore, this system is used in applications where acceleration/deceleration is carried out frequently, so the selection differs from the methods for selecting the conventional power supply unit.

Power supply unit capacity >Σ (Spindle motor output)
+Σ (Capacity of servo amplifier driving linear motor)
+0.7 × Σ (Rotary servomotor output) ··· (3-5)
* When using two or more axes with the rotation motor

Select a power supply unit capacity having the minimum lineup capacity that satisfies expression (3-5).

(Caution) With the linear servo axis, this is used for an axis with a high acceleration/deceleration frequency compared to that multiplied by 0.7 when using two or more axes with the rotation motor, so the value does not need to be multiplied by 0.7.

POINT

Refer to the "MELDAS AC Servo and Spindle MDS-A Series, MDS-B Series Specifications BNP-B3759B" for other details on the power supply unit.

3-3 Selecting the power supply capacity, wire size, AC reactor, contactor and NFB

POINT

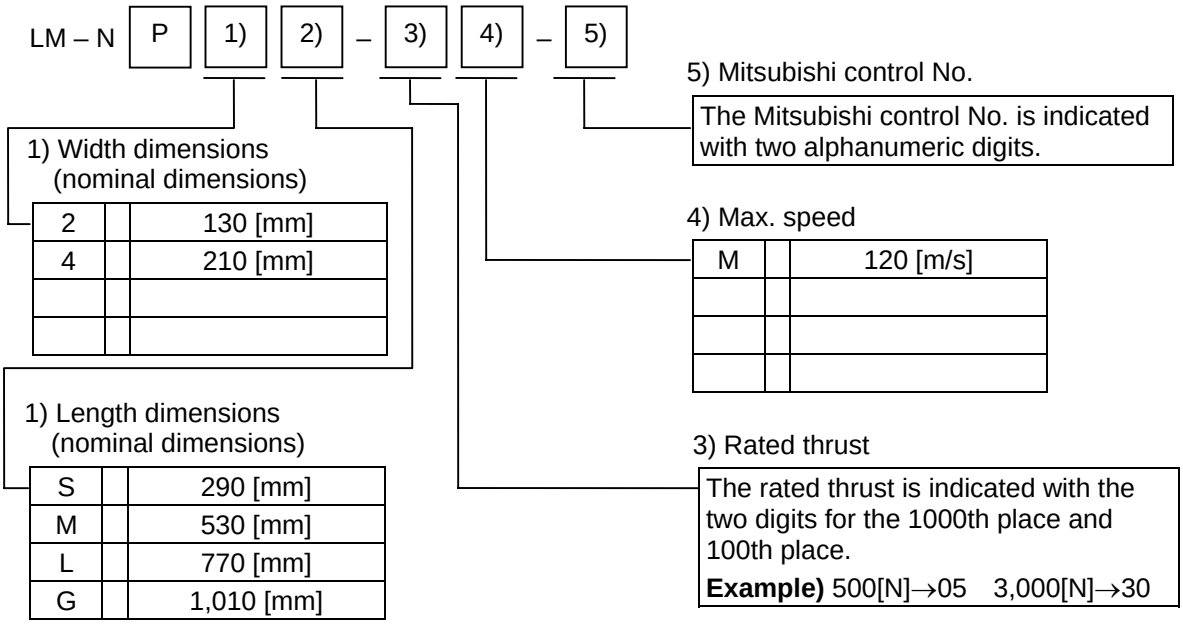
The selection of the power supply capacity, wire size, AC reactor, contactor and NFB is the same as the MDS-B-V1 unit.
Refer to the "MELDAS AC Servo and Spindle MDS-A Series, MDS-B Series Specifications BNP-B3759B".

Chapter 4 Linear Servomotor Specifications

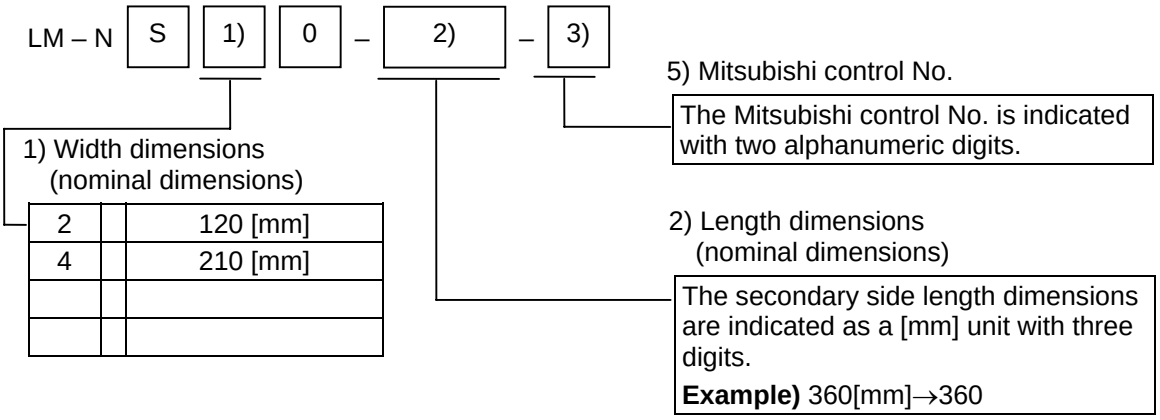
4-1 Type configuration

The type indication for the linear servomotor differs for the primary side and secondary side.

(1) Primary side



(2) Secondary side



⚠ CAUTION

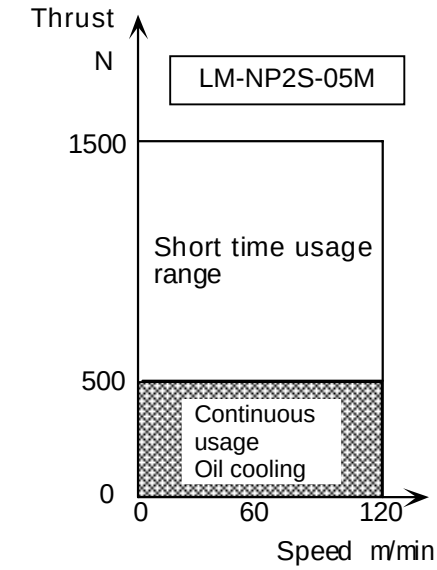
* The combination of the primary side and secondary side is indicated with the type symbol 1).
  Select a model that has the same type symbol 1) for the primary side and secondary side.

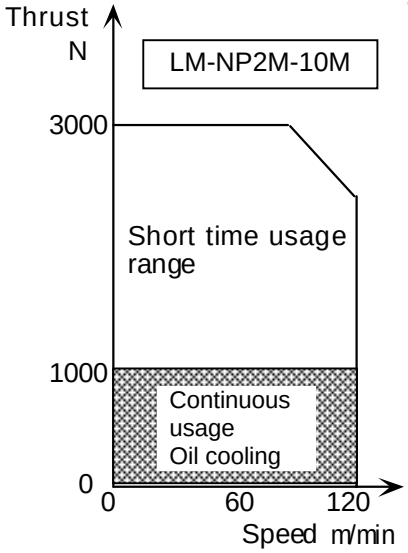
4-2 List of specifications

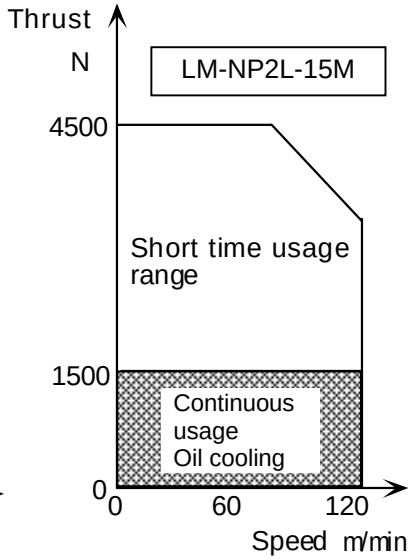
Item \ Type		Unit	LM-NP2S-05M		LM-NP2M-10M		LM-NP2L-15M		LM-NP4S-10M		LM-NP4M-20M		LM-NP4L-30M		LM-NP4G-40M	
Cooling method			Self-cool-ing	Oil-cool-ing	Self-cool-ing	Oil-cool-ing	Self-cool-ing	Oil-cool-ing	Self-cool-ing	Oil-cool-ing	Self-cool-ing	Oil-cool-ing	Self-cool-ing	Oil-cool-ing	Self-cool-ing	Oil-cool-ing
Thrust	Conti-nuous	N	250	500	500	1000	750	1500	500	1000	1000	2000	1500	3000	2000	4000
	Max.	N	1500		3000		4500		3000		6000		9000		12000	
Current	Conti-nuous	A	5	11	7	15	11	23	7	15	11.5	24	18	38	25	52
	Max.	A	40		55		83		55		84		138		188	
Output (continuous)		kW	0.5	1.0	1.0	2.0	1.5	3.0	1.0	2.0	2.0	4.0	3.0	6.0	4.0	8.0
Power voltage		V	200													
Max. speed		m/min	120													
Magnet attraction force		N	3750		7500		11250		7500		15000		22500		30000	
Coil resistance (1-phase at 20°C)		Ω	1.43		1.40		0.92		1.15		0.77		0.44		0.32	
Weight	Primary side (coil)	kg	8.5		15		22		14.5		27		40		53	
	Secondary side (magnet)	kg	(360mm 1pc.) 5 (540mm 1pc.) 7.5						(360mm 1pc.) 9 (540mm 1pc.) 13.5							
Drive amplifier type			MDS-B-V14 L-20		MDS-B-V14 L-35		MDS-B-V14 L-45		MDS-B-V14 L-35		MDS-B-V14 L-45		MDS-B-V14 L-90		MDS-B-V14 L-110	

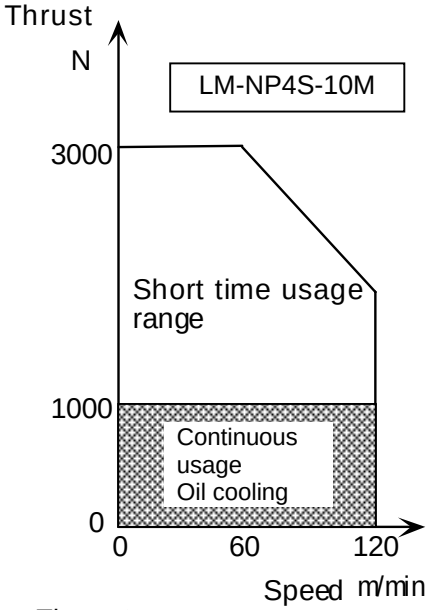
Caution 1. The above values are the design values, and are subject to change without notice.

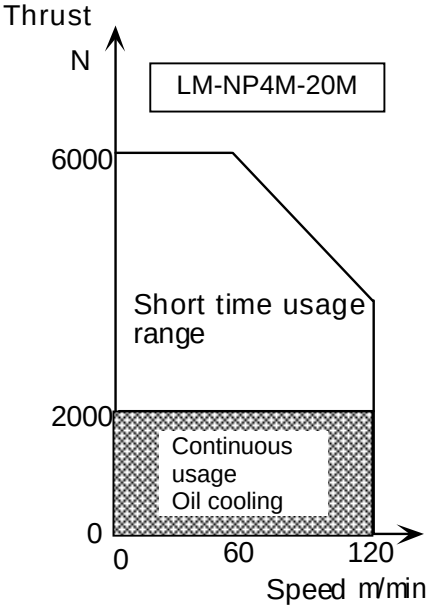
4-3 Speed – torque characteristics drawing (At input voltage 200VAC)

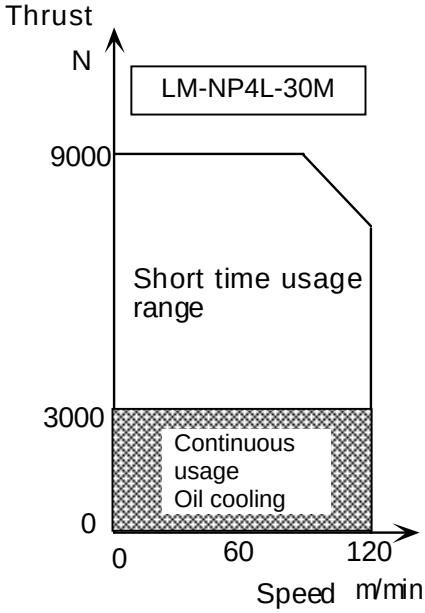


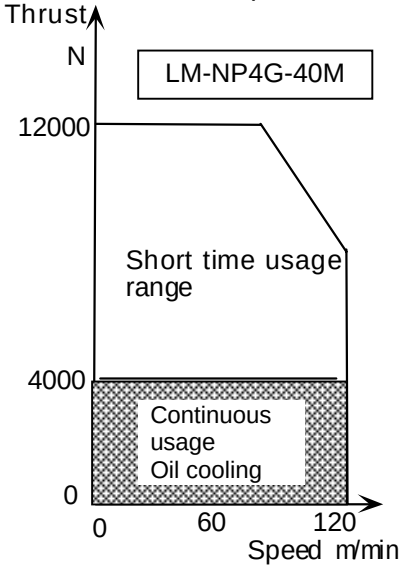












4-4 Dynamic brake characteristics

When the system detects an abnormality, the motor stops the machine using the dynamic brakes. The machine's coasting amount at this time can be calculated with the following expression.

$$Lmax = \frac{F0}{60} \times [\, 0.03 + M \times \{ A + B \times F0^2 \} \times 1.1 \,] \quad \cdots (4\text{-}1)$$

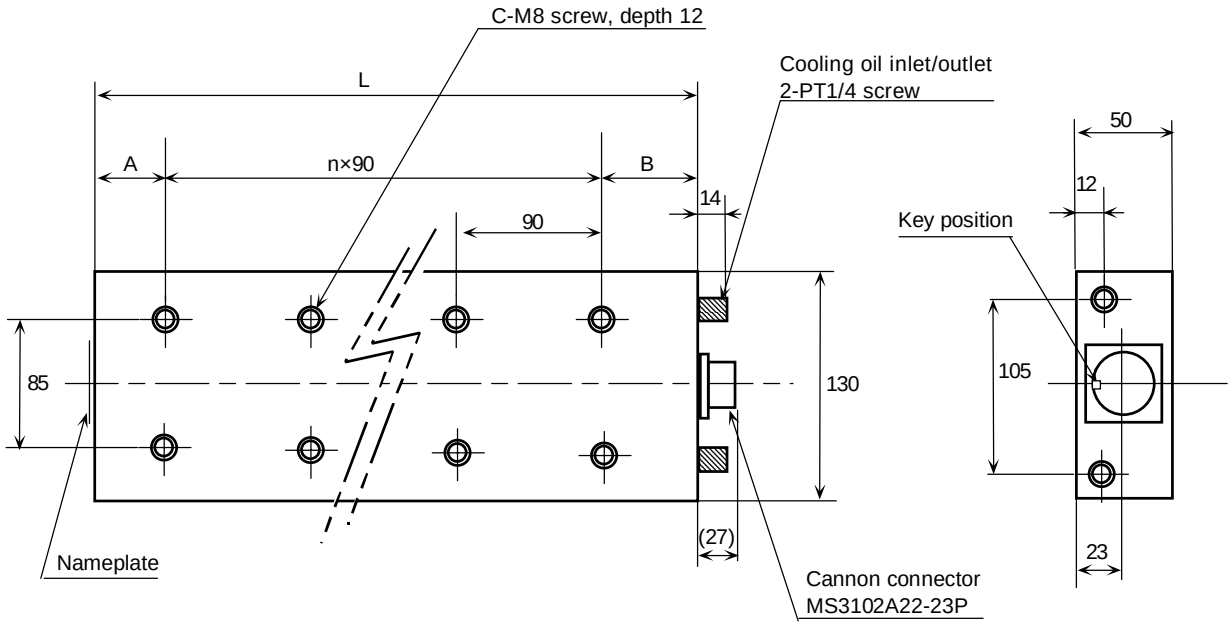
Lmax	: Machine coasting amount	(m)
F0	: Speed during brake operation	(m/min)
M	: Total weight of moving section	(kg)
A	: Coefficient (according to following table)	
B	: Coefficient (according to following table)	

(Note) Lmax has a ±10% variation due to the motor's inductive voltage constant.

Motor type	Coefficient A	Coefficient B
LM-NP2S-05M	2.13×10^{-3}	4.5×10^{-8}
LM-NP2M-10M	1.04×10^{-3}	2.26×10^{-8}
LM-NP2L-15M	8.22×10^{-4}	1.3×10^{-8}
LM-NP4S-10M	9.03×10^{-4}	2.61×10^{-8}
LM-NP4M-20M	4.59×10^{-4}	1.11×10^{-8}
LM-NP4L-30M	3.73×10^{-4}	6.18×10^{-9}
LM-NP4G-40M	2.26×10^{-4}	5.74×10^{-9}

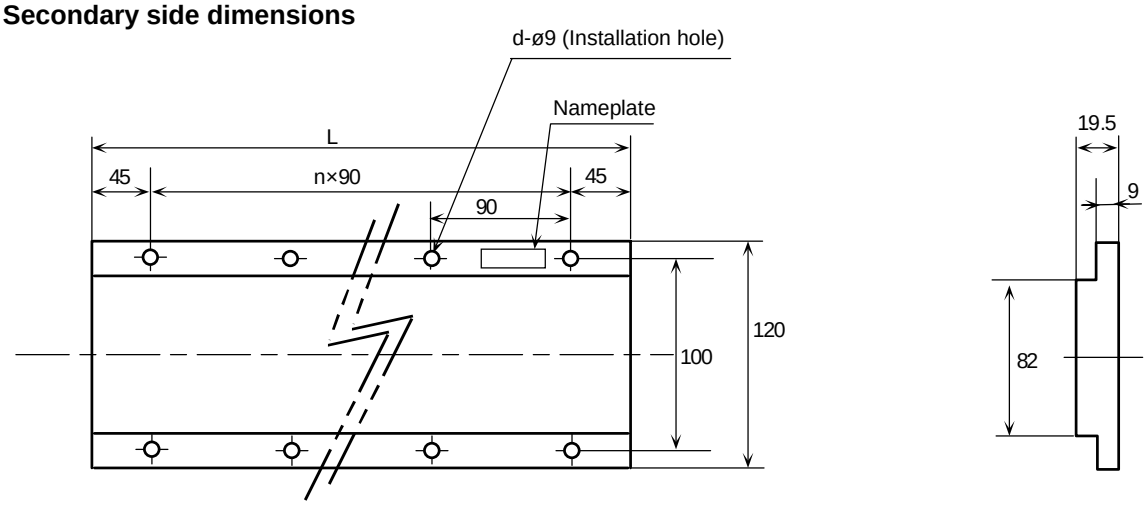
4-5 Outline dimensions

Primary side dimensions



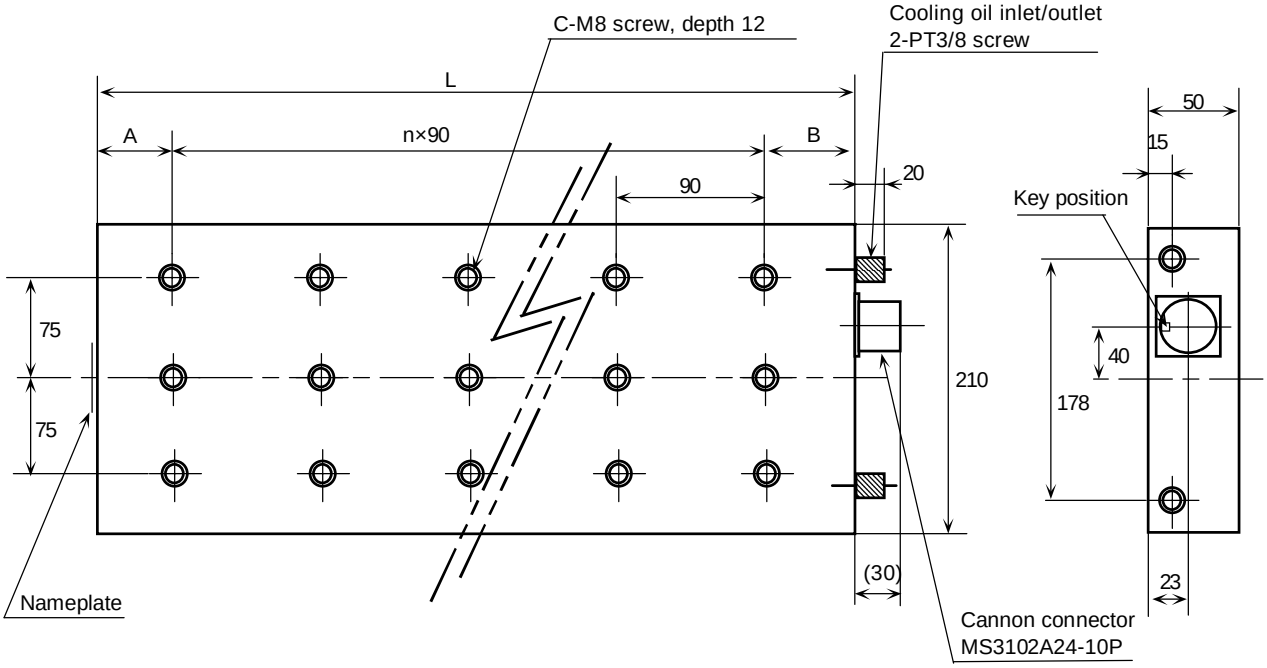
Changed dimensions / Type	L	A	B	C	n
LM-NP2S-05M	290	55	55	3 × 2	2
LM-NP2M-10M	530	85	85	5 × 2	4
LM-NP2L-15M	770	70	70	8 × 2	7

Secondary side dimensions



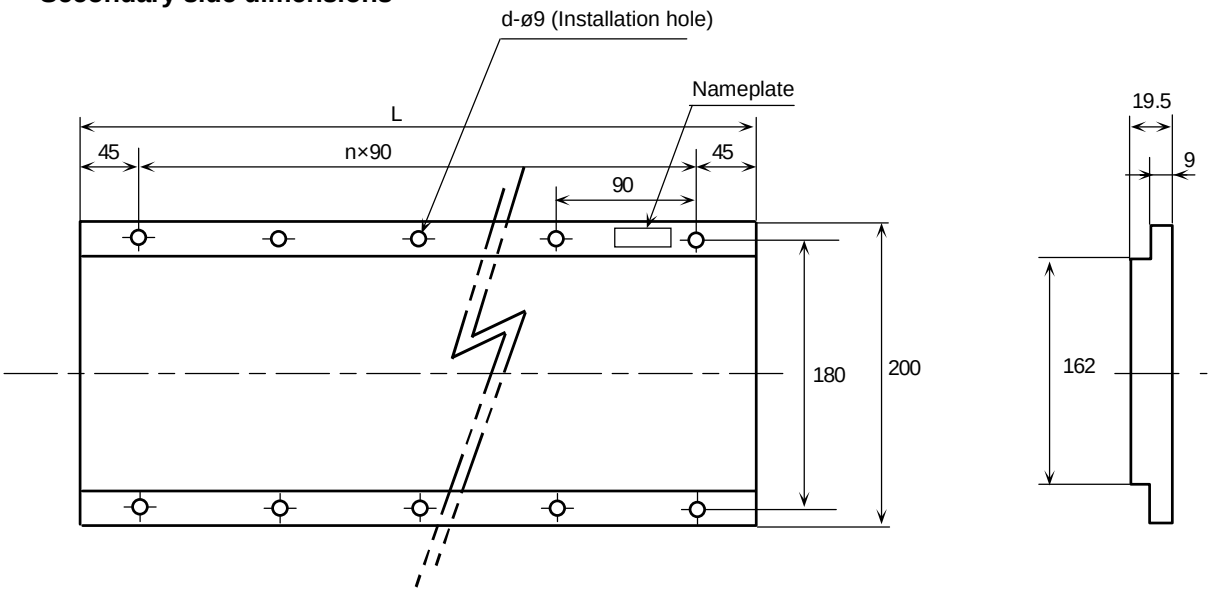
Changed dimensions / Type	L	d	n
LM-NS20-360	360	4 × 2	3
LM-NS20-540	540	6 × 2	5

Primary side dimensions



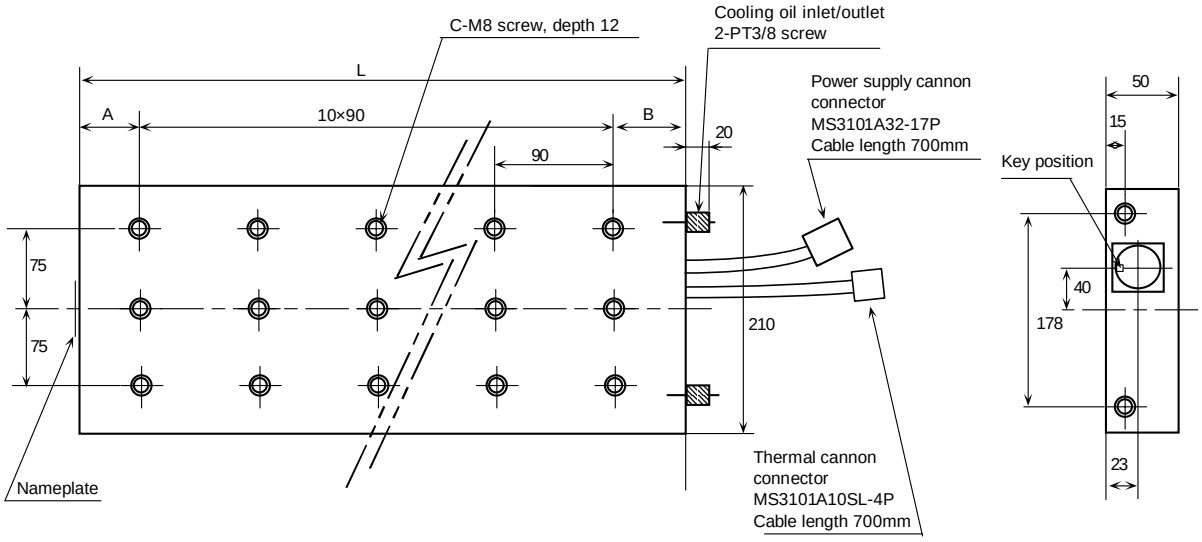
Changed dimensions / Type	L	A	B	C	n
LM-NP4S-10M	290	55	55	3 × 3	2
LM-NP4M-20M	530	85	85	5 × 3	4
LM-NP4L-30M	770	70	70	8 × 3	7

Secondary side dimensions



Changed dimensions / Type	L	d	n
LM-NS40-360	360	4 × 2	3
LM-NS40-540	540	6 × 2	5

Primary side dimensions



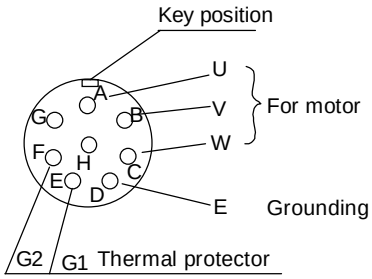
Changed dimensions / Type	L	A	B	C
LM-NP4G-40M	1010	55	55	11 × 3

4-6 Explanation of connectors

For LM-NP2 (S, M, L)

Pin symbol	Lead wire side
A B C	U V W } For motor
D	E Grounding
E F	G1 G2 } Thermal protector
G H	Blank

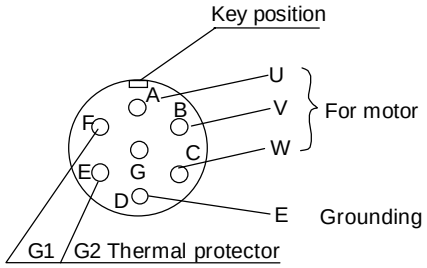
(MS3102A22-23P)



For LM-NP4 (S, M, L)

Pin symbol	Lead wire side
A B C	U V W } For motor
D	E Grounding
E F	G1 G2 } Thermal protector
G	Blank

(MS3102A24-10P)



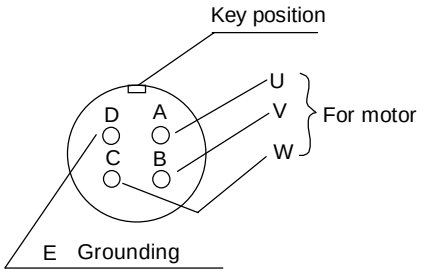
For LM-NP4G

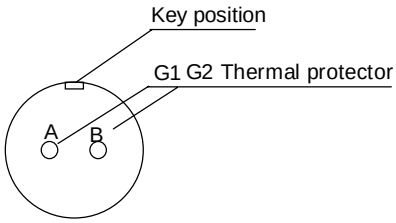
Pin symbol	Lead wire side	
A	U	For motor
B	V	
C	W	
D	Grounding	

(MS3101A32-17P)

Pin symbol	Lead wire side	
A	G1	Thermal protector
B	G2	

(MS3101A10SL-4P)





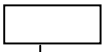
⚠ CAUTION Connect the thermal protector lead wire parallel to the emergency stop circuit on the CNC control unit, or connect it to the scale I/F unit (MDS-B-HR).

⚠ CAUTION If oil-proofing is required, use the oil-proof specification part for the cannon connector on the cable side.

POINT Use an MS type cannon connector compatible with the Mitsubishi rotation type (HA type, HC type) AC servomotor.

Chapter 5 Servo Drive Specifications

5-1 Type configuration

MDS-B-V14L- 

Capacity class symbol	01	03	05	10	20	35	45	70	90	110	150
Capacity (kW)	0.1 kW	0.3 kW	0.5 kW	1.0 kW	2.0 kW	3.5 kW	4.5 kW	7.0 kW	9.0 kW	11.0 kW	15.0 kW

5-2 List of specifications

Amplifier type	MDS-B-V14L-										
Capacity class symbol	01	03	05	10	20	35	45	70	90	110	150
Output voltage (V)	155										
Continuous output current (A)	1.4	3.0	5.0	8.8	18.2	25.0	44.0	50.0	50.0	52.0	52.0
Max. output current (A)	3.9	8.1	17.0	28.0	42.0	57.0	85.0	113	141	204	260
Control method	Sine wave PWM method										
Main circuit method	Transistor, inverter (Intelligent power module using IGBT)										
Braking	Dynamic brakes and deceleration to stop										
Tolerable load inertia	As a guide, 2.5-times the motor inertia										
Tolerable ambient temperature	0°C to 55°C (with no freezing)										
Tolerable ambient humidity	90% (RH) or less (with no dew condensation)										
Storage temperature	–15°C to 70°C (with no freezing)										
Storage humidity	90% (RH) or less (with no dew condensation)										
Atmosphere	Indoors (away from direct sunlight) With no corrosive gases, combustible gases and oil mist or dust										
Tolerable vibration	$4.9 m/s^2$										
Tolerable impact	Acceleration $49 m/s^2$: when packaged										
Max. heating amount (W)	*26	*32	*45	*65	104	150	208	318	370	400	550
Weight (kg)	3.5	3.5	3.5	4.5	4.5	4.5	6.0	7.0	7.0	10.0	10.0
Capacity (kW)	0.1	0.3	0.5	1.0	2.0	3.5	4.5	7.0	9.0	11.0	15.0
Torque limit range	0 to 100%										
Noise dB (A)	Within 55dB										

(Note 1) The heating amount is the value for the rated output.

(Note 2) When installed in a sealed state, the guide for the heating amount outside the panel must be calculated with the following expression.

Heating amount outside panel =
(Max. heating amount described in specifications above – 15) × 0.85

Note that the units marked with a * in the above specifications do not have a fin, so the heating amount is only for inside the panel.

(Note 3) Due to the structure, heat will easily accumulate in each unit. Thus, install a fan in the power distribution panel to agitate the heat at the top of the unit. (Velocity 2m/s or more)

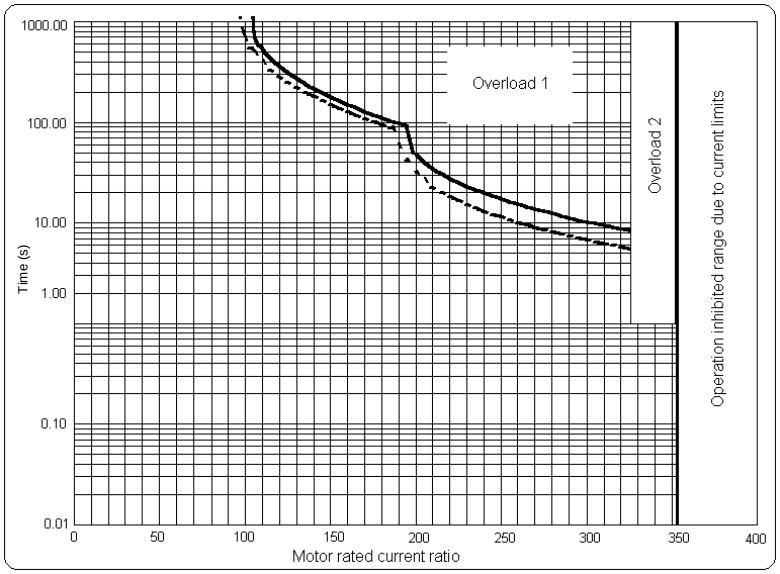
⚠ CAUTION

The MDS-B-V14L-110 and MDS-B-V14L-150 do not have built-in dynamic brakes. An external dynamic brake unit must be provided.
Refer to the section 5-6 Dynamic brake unit.

5-3 Overload protection specifications

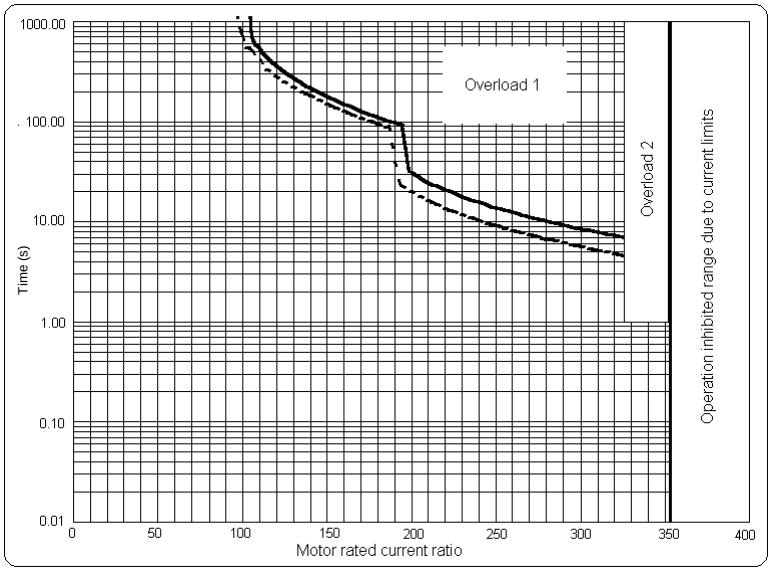
The servo amplifier has an electronic thermal to protect the servomotor and servo amplifier from overloads. The operation characteristics of the electronic thermal are shown below.
If overload operation exceeding the electronic thermal protection curve shown below, the overload 1 (alarm 50) will occur. If a current exceeding 95% of the max. current continuously flows for one second or more due to a machine collision, etc., overload 2 (alarm 51) will occur.

Motor	: LM-NP2S, NP2M, NP4S
Servo amplifier	: MDS-B-V14L-20, 35



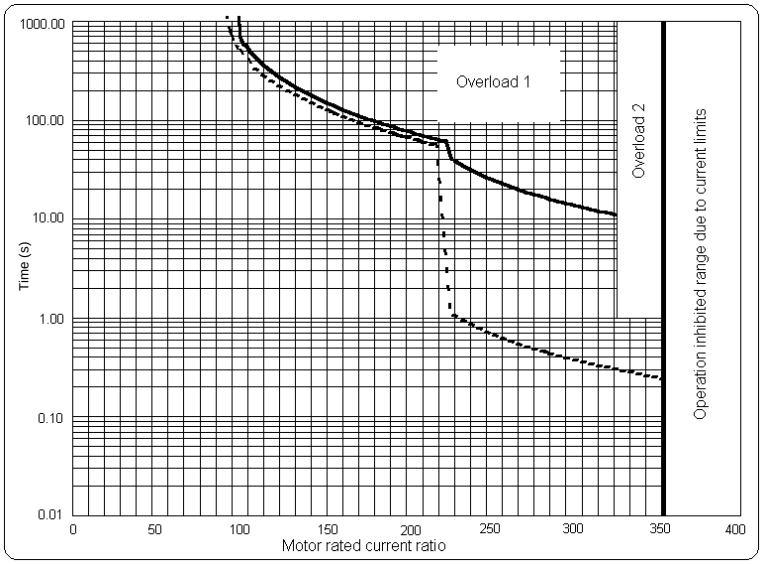
When operating
When stopped

Motor	: LM-NP2L, NP4M
Servo amplifier	: MDS-B-V14L-45



When operating
When stopped

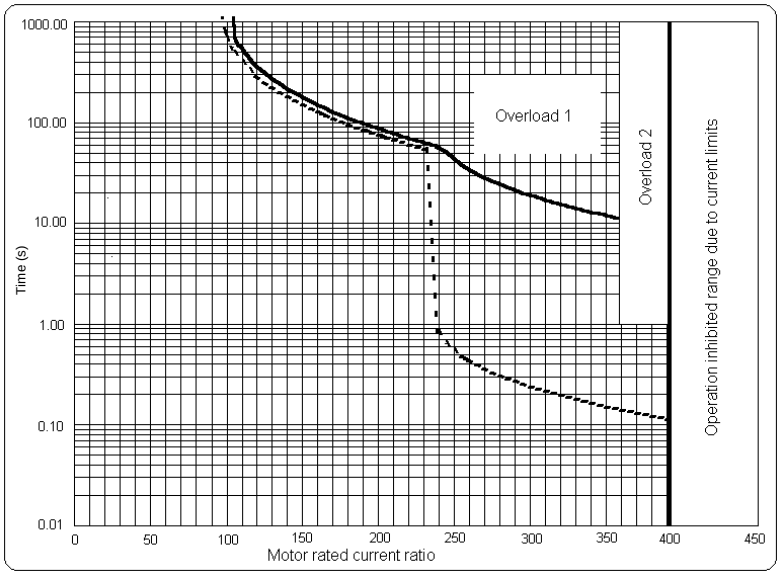
Motor	: LM-NP4L
Servo amplifier	: MDS-B-V14L-90



When operating

When stopped

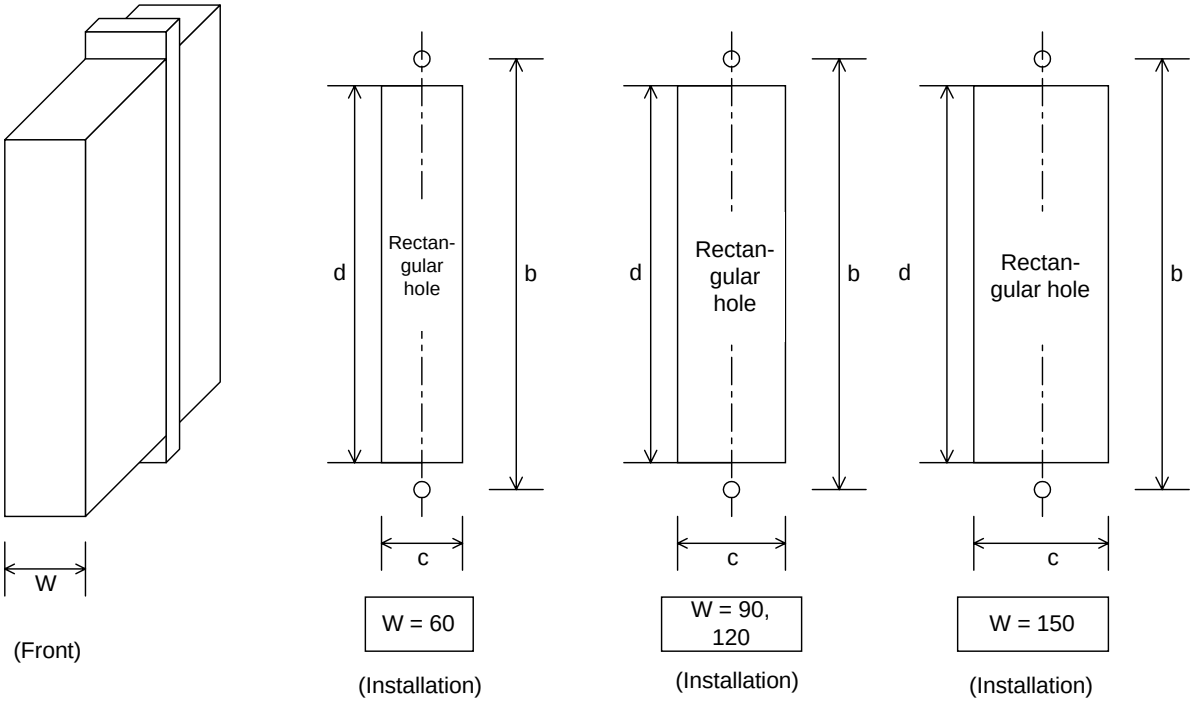
Motor	: LM-NP4G
Servo amplifier	: MDS-B-V14L-110

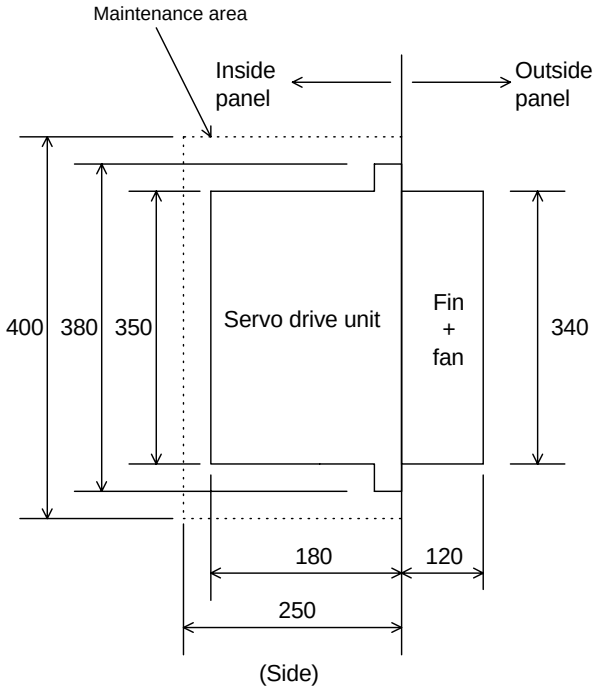


When operating

When stopped

5-4 Outline dimensions

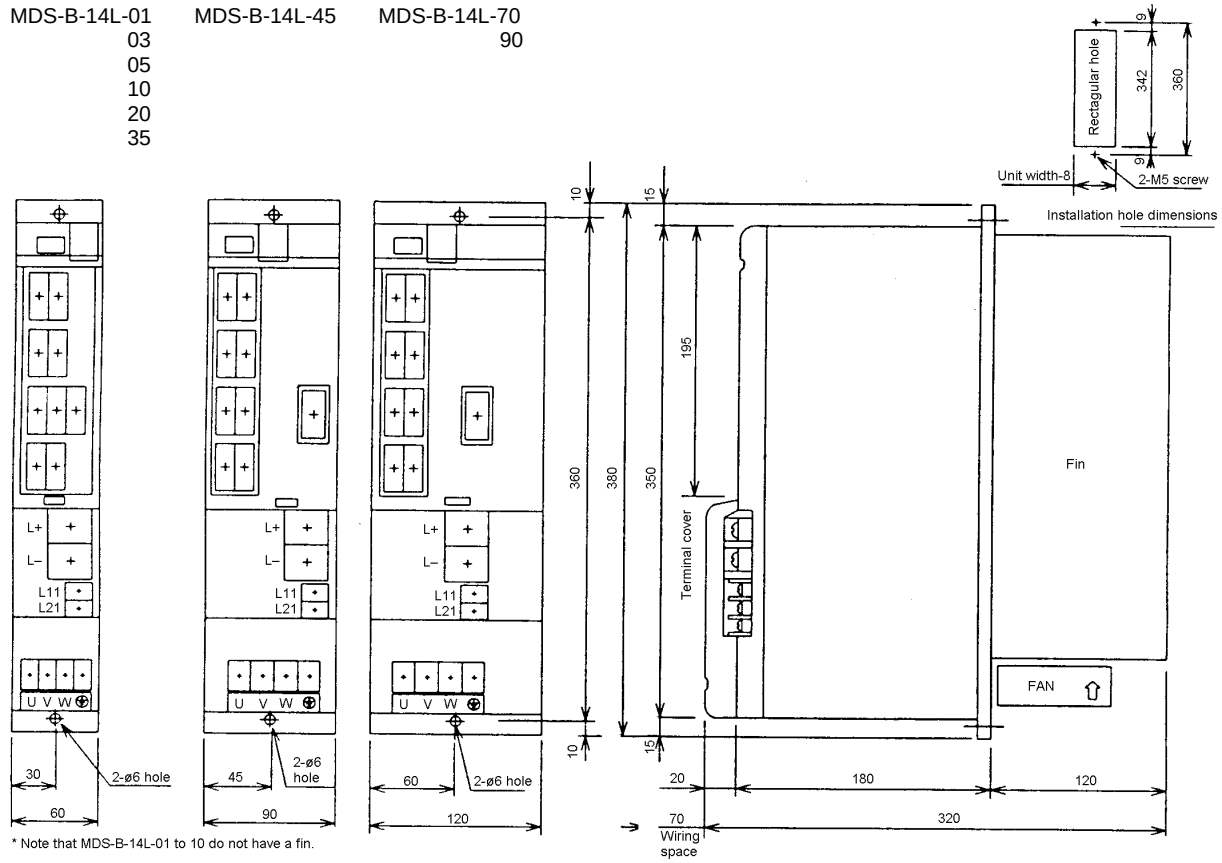




(Note) The outline dimension type A0 unit indicated in 2-2 List of units and corresponding linear motors does not have the fin + fan section.

Capacity	Servo drive unit			
	to 3.5kW	4.5kW	7 to 9kW	11 to 15kW
W	60	90	120	150
b	360	360	360	360
c	52	82	112	142
d	342	342	342	342

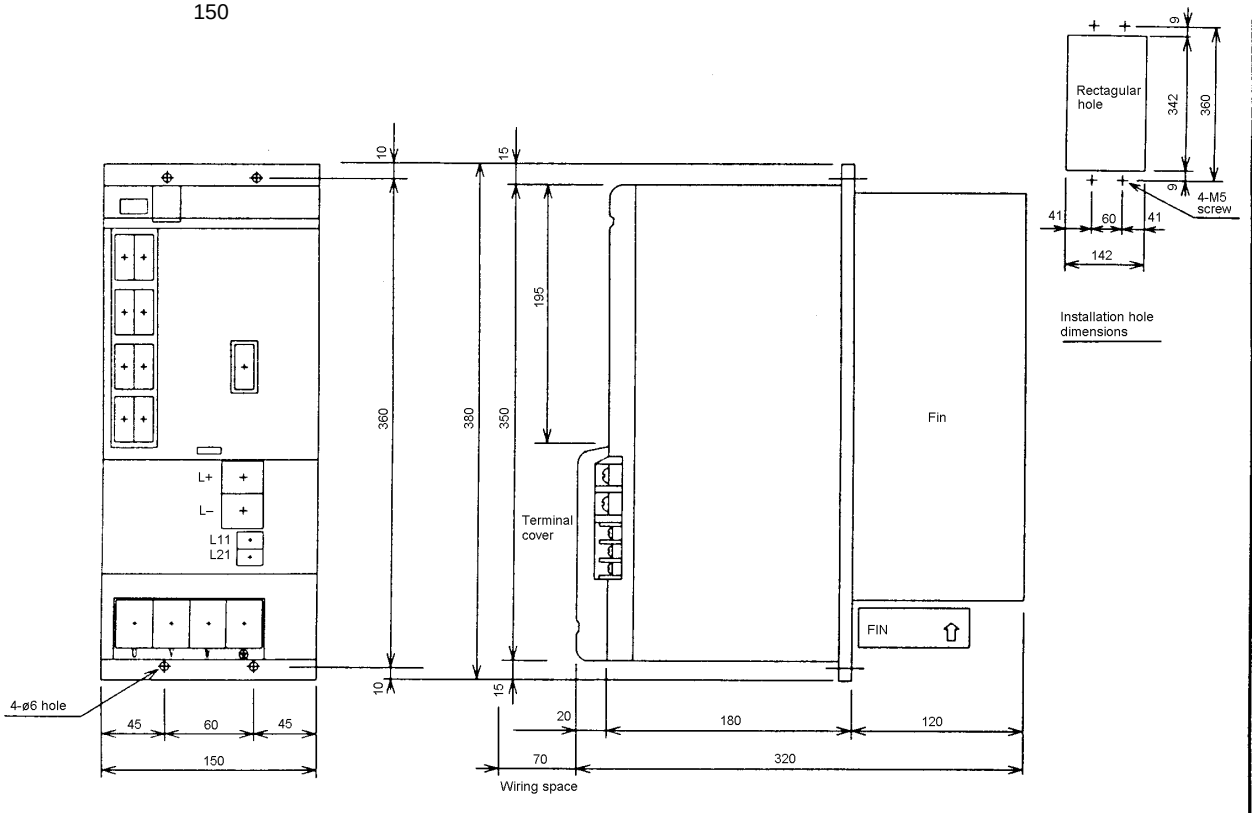
MDS-B-14L-01 MDS-B-14L-45 MDS-B-14L-70
03 90
05
10
20
35



* Note that MDS-B-14L-01 to 10 do not have a fin.

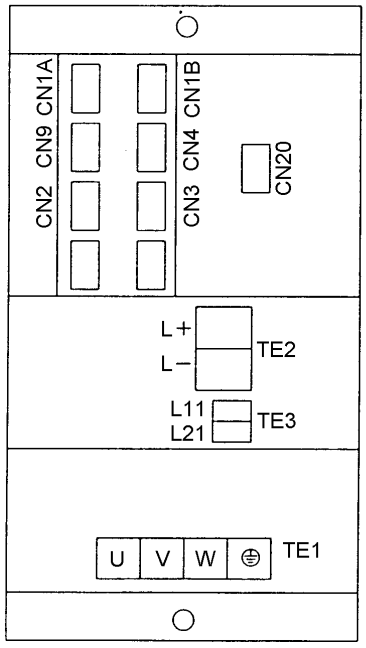
(Note) The front view drawing shows the state with the terminal cover removed.

MDS-B-14L-110
150



5-5 Explanation of connectors and terminal blocks

		Name	Application	Remarks
Connector		CN1A CN1B	Connection of CNC and upward axis Connection of battery unit and downward axis	
		CN9	Maintenance (normally not used)	
		CN4	Connection with power supply	
		CN2	Connection with motor end detector	
		CN3	Connection with machine end detector	
		CN20	External brake output contact	Also used for V14L-110/150 dynamic brake contact output
Terminal block	TE2	L+ L–	Converter voltage input (+) Converter voltage input (–)	
	TE3	L11 L21	200VAC single-phase input	
	TE1	U V W	Motor drive U-phase output Motor drive V-phase output Motor drive W-phase output	

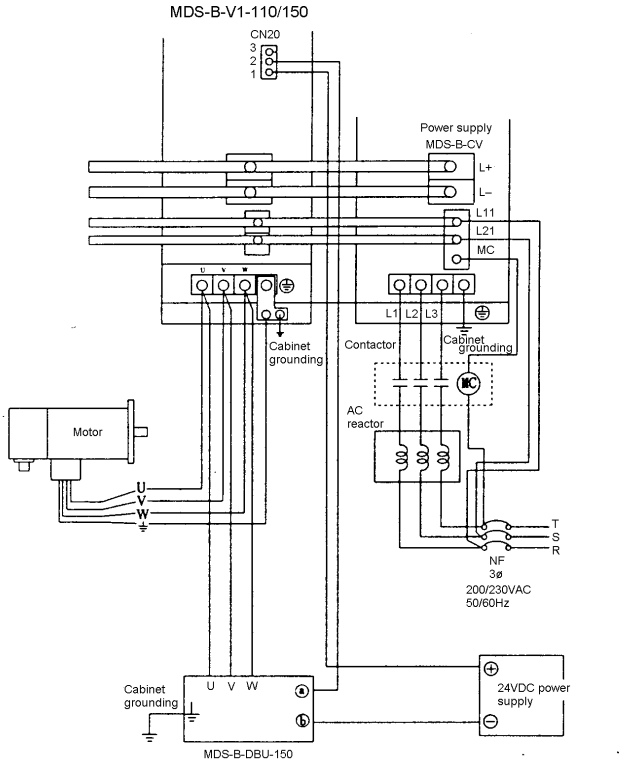


5-6 Dynamic brake unit

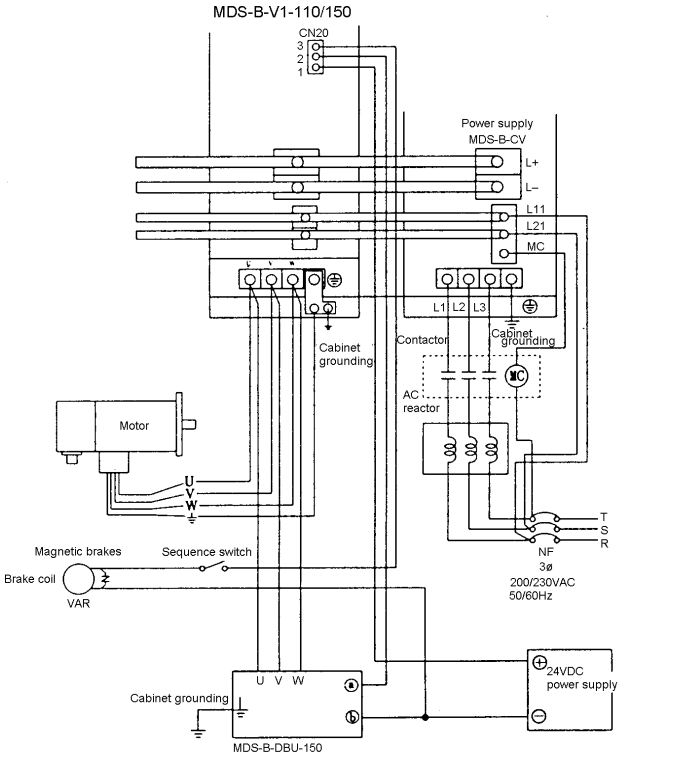
The MDS-B-V14L-110 and MDS-B-V14L-150 do not have built-in dynamic brakes. An external dynamic brake unit must be provided.

5-6-1 Connection of dynamic brake unit

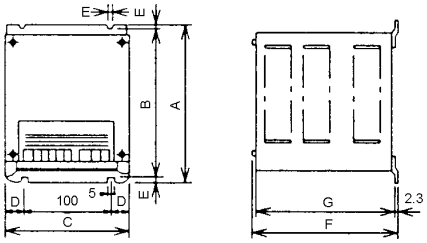
(1) For only dynamic brake unit



(2) For dynamic brake unit + magnetic brakes (combined use)



5-6-2 Outline dimensions of dynamic brake unit



Type	A	B	C	D	E	F	G	Weight	Applicable servo amplifier
MDS-B-DBU-150	200	190	140	20	5	200	193.8	2kg	MDS-B-V14L-110/150

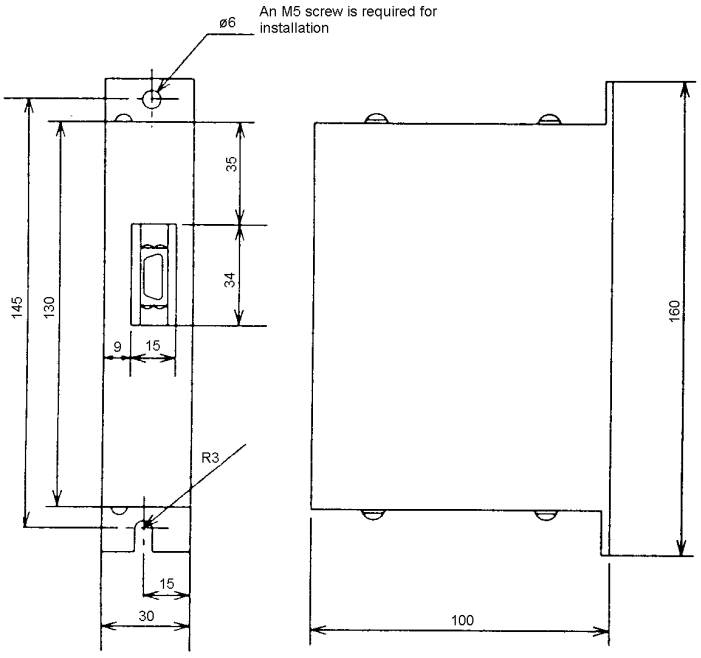
5-7 Battery unit

For the linear servo system, a battery-less linear scale (AT342, LC191M) is used for the absolute position detector used in the absolute position system. Thus, basically the battery unit is not required. However, in a system using a rotation motor for the other axes, a battery unit is required for the CNC system.

5-7-1 Connection of battery unit

Refer to 7-2-11 Connection of battery unit.

5-7-2 Outline dimensions of battery unit



MDS-A-BT-2
4
6
8

* Common for MDS-A Series and MDS-B Series.

Chapter 6 Detector Specifications

6-1 Linear scale

The following types of scales can be used with the linear servo drive system.

- Only some of the types are listed here. Note that the application may change due to changes in the specifications and termination of production by the scale maker.
- Select a scale from the scale maker's catalog, which satisfies the specifications given in 6-2 Scale I/F unit specifications.

(1) Linear scales that can be used as single part

- For absolute (absolute value) system (Battery unit not required)

Maker	Scale type	Scale specifications (excerpt)
Mitsutoyo	AT342	Max. operation speed 110m/min., resolution 0.5μm
Heidenhain	LC191M	Max. operation speed 120m/min., resolution 0.1μm

(2) Linear scales usable as combination with MDS-B-HR scale I/F unit

- For incremental (incremental value) system

Maker	Scale type	Scale specifications (excerpt)
Mitsutoyo	AT342 (Special)	Max. operation speed 110m/min., resolution 0.04μm
Heidenhain	LS186	Max. operation speed 120m/min., resolution 0.04μm
	LIDA181	Max. operation speed 480m/min., resolution 0.08μm
	LIF181	Max. operation speed 48m/min., resolution 0.008μm

∗ The resolutions listed above are for combination with the MDS-B-HR unit.

∗ When using the AT342 (special) scale, an absolute position system can be assembled even when used in combination with the MDS-B-HR unit. Note that the resolution of the absolute position recovered when the power is turned ON will be 0.5μm.

6-2 Scale I/F unit

6-2-1 Outline

MDS-B-HR outline

(1) The scale analog output source waves are interpolated to generate high resolution position data. This is effective for increasing the servo's high gain by increasing the detector's resolution.

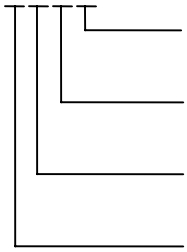
(2) The linear motor's pole position data is generated with the source waves output by the MDS-B-MD (pole detection unit).

(3) 1-scale, 2-driver operation is possible with the signal branching function (with type class).

6-2-2 Type configuration

MDS-B-HR type configuration

MDS-B-HR-□□□□



Protection format class
No symbol: IP65 P: IP67

Pole detection unit compatibility class
No symbol: Not MD compatible M: MD compatible

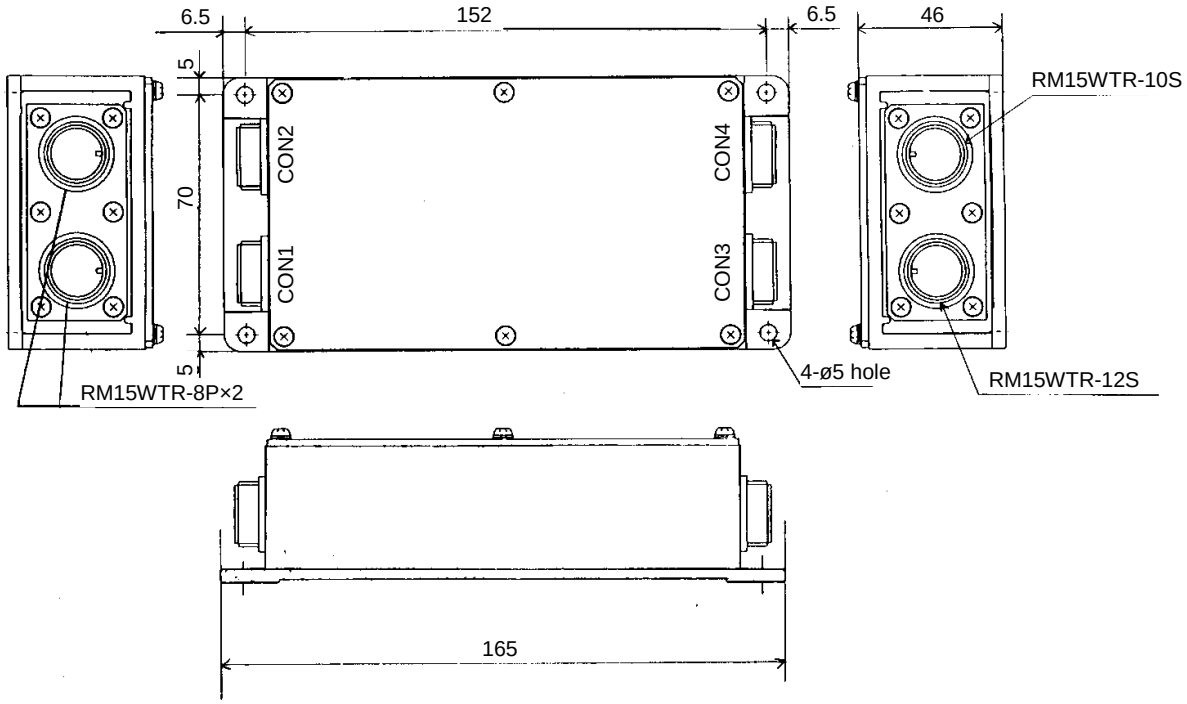
Signal branching function class
1: No. of outputs 1 2: No. of outputs 2 (with branching)

Scale output voltage class
1: Scale output voltage 1V_{p-p} specifications
2: Scale output voltage 2 V_{p-p} specifications

6-2-3 List of specifications

	Unit	Scale I/F unit type															
		MDS-B-HR-		MDS-B-HR-		MDS-B-HR-		MDS-B-HR-		MDS-B-HR-		MDS-B-HR-		MDS-B-HR-		MDS-B-HR-	
		11	12	11P	12P	21	22	21P	22P	11M	12M	11MP	12MP	21M	22M	21MP	22MP
Corresponding scale		LS186, LIDA181, LIF181: Heidenhain				AT342 special (Mitsutoyo)				LS186, LIDA181, LIF181: Heidenhain				AT342 special (Mitsutoyo)			
Pole detector connection		Connection not possible				Connection not possible				Connection possible				Connection possible			
Two signal distribute function		×	○	×	○	×	○	×	○	×	○	×	○	×	○	×	○
Analog signal input specifications		A phase, B phase, Z phase 2.5V standard Amplitude $1V_{p-p}$				A phase, B phase, Z phase 2.5V standard Amplitude $2V_{p-p}$				A phase, B phase, Z phase 2.5V standard Amplitude $1V_{p-p}$				A phase, B phase, Z phase 2.5V standard Amplitude $2V_{p-p}$			
Corresponding frequency		Analog source waveform 200kHz max															
Scale resolution		Analog source waveform/512 division															
Input/output communication type		High-speed serial communication I/F (MDS-B-V×4 specifications), equivalent to RS485															
Pole detector compatibility		Not compatible								Compatible							
Tolerable ambient temperature	°C	0 to 55°C															
Tolerable ambient relative humidity	% (RH)	90% (RH) or less (with no dew condensation)															
Atmosphere		No toxic gases															
Tolerable vibration	m/s^2	$98m/s^2$															
Tolerable impact	m/s^2	$294m/s^2$															
Tolerable power voltage	V	5VDC ± 5%															
Max. heating amount	W	2W															
Weight	kg	0.5kg or less															
Protection type		IP65		IP67		IP65		IP67		IP65		IP67		IP65		IP67	

6-2-4 Outline dimensions



6-2-5 Explanation of connectors

Connector name	Application	Remarks
CON1	Connection with servo amplifier (2nd system)	Not required for 1-system specifications
CON2	Connection with servo amplifier	
CON3	Connection with scale	
CON4	Connection with pole detection unit (MDS-B-MD)	

Connector pin layout

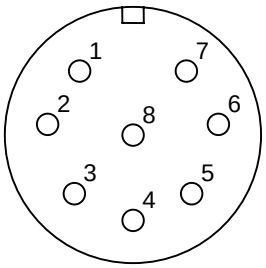
CON1	
Pin No.	**Function**
1	RQ+ signal
2	RQ– signal
3	SD+ signal
4	SD– signal
5	P5
6	P5
7	GND
8	GND

CON2	
Pin No.	**Function**
1	RQ+ signal
2	RQ– signal
3	SD+ signal
4	SD– signal
5	P5
6	P5
7	GND
8	GND

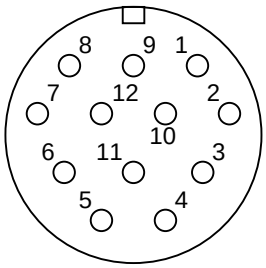
CON3	
Pin No.	**Function**
1	A+ phase signal
2	A– phase signal
3	B+ phase signal
4	B– phase signal
5	Z+ phase signal
6	Z– phase signal
7	RQ+ signal
8	RQ– signal
9	SD+ signal
10	SD– signal
11	P5
12	GND

CON1	
Pin No.	**Function**
1	A phase signal
2	REF signal
3	B phase signal
4	REF signal
5	P24
6	MOH signal
7	P5
8	P5
9	TH signal
10	GND

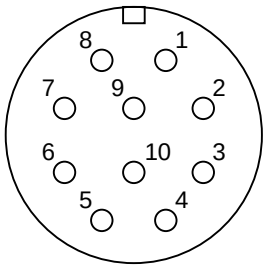
Connector: RM15WTR-8P (Hirose) ·····CON1, CON2
RM15WTR-12S (Hirose) ·····CON3
RM15WTR-10S (Hirose) ·····CON4



CON1
CON2



CON3



CON4

6-3 Pole detection unit

6-3-1 Outline

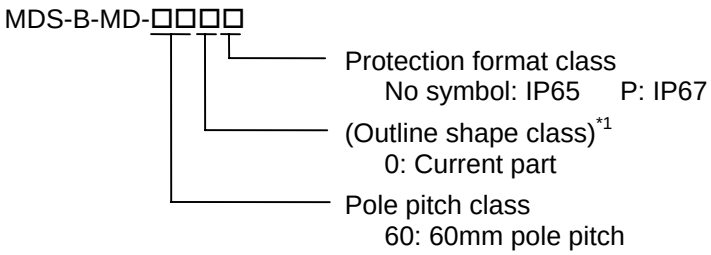
Outline of MDS-B-MD

(1) This unit detects the pole of the linear motor's secondary side magnet and outputs an analog voltage.
When using an incremental specification scale, always install this unit.

* Pole alignment when the power is turned ON will not be necessary.

6-3-2 Type configuration

MDS-B-MD type configuration

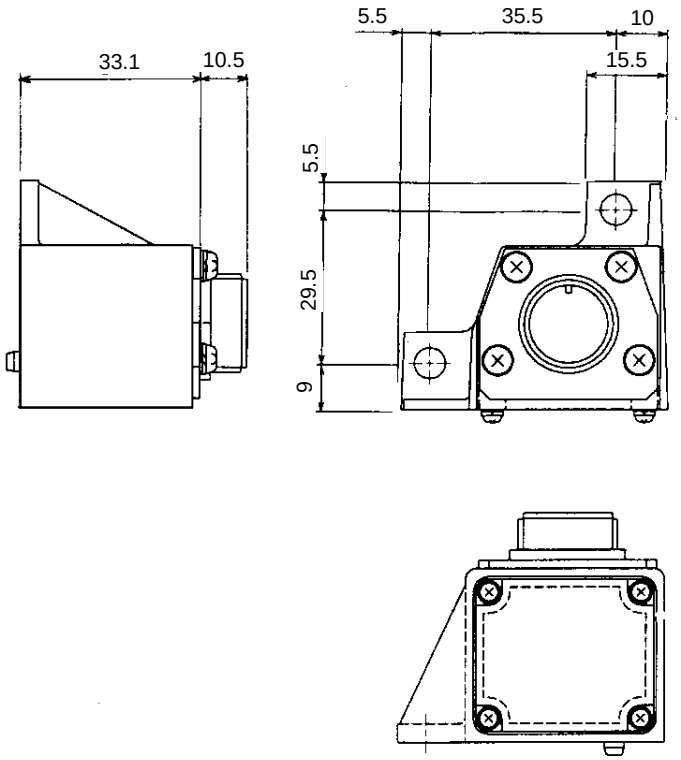


*1 This is a class reserved for future use. Currently there is only one type.

6-3-3 List of specifications

	Unit	Pole detection unit type	
		MDS-B-MD-600	MDS-B-MD-600P
Tolerable ambient temperature	°C	0 to 55°C	
Tolerable ambient relative humidity	% (RH)	90% (RH) or less (with no dew condensation)	
Atmosphere		No toxic gases	
Tolerable vibration	m/s^2	$98m/s^2$	
Tolerable impact	m/s^2	$294m/s^2$	
Tolerable power voltage	V	5VDC ± 5%	
Max. heating amount	W	1W or less	
Weight	kg	0.1kg or less	
Protection type		IP65	IP67

6-3-4 Outline dimensions

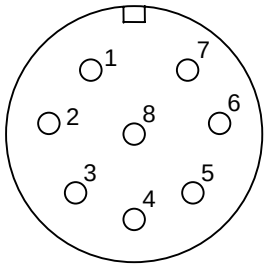


6-3-5 Explanation of connectors

Connector name	Application	Remarks
CON1	Connection with scale I/F unit (MDS-B-HR)	

Connector pin layout

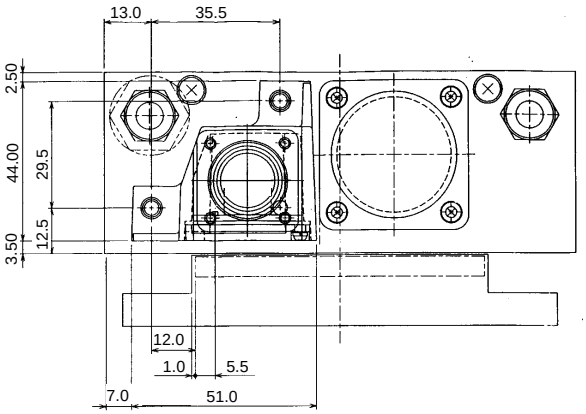
CON1	
Pin No.	**Function**
1	A phase signal
2	REF signal
3	B phase signal
4	REF signal
5	TH signal
6	P5
7	P5
8	GND



Connector: RM15WTR-8P (Hirose) ·····CON1

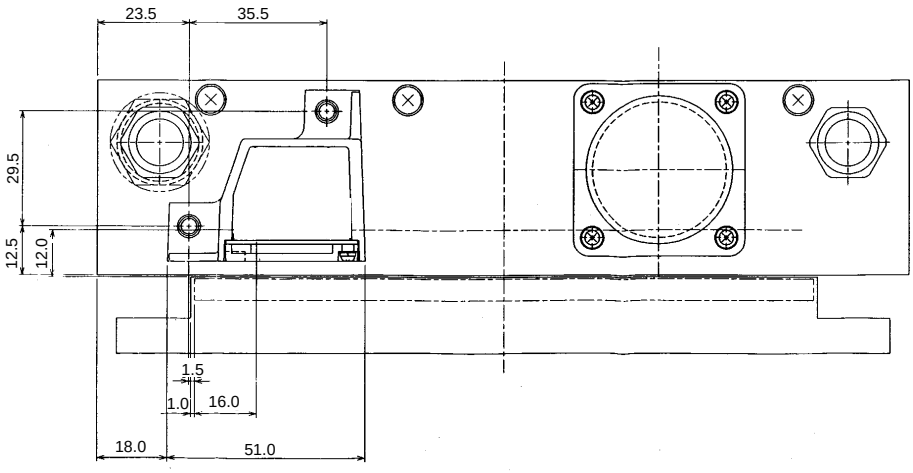
6-3-6 Installation

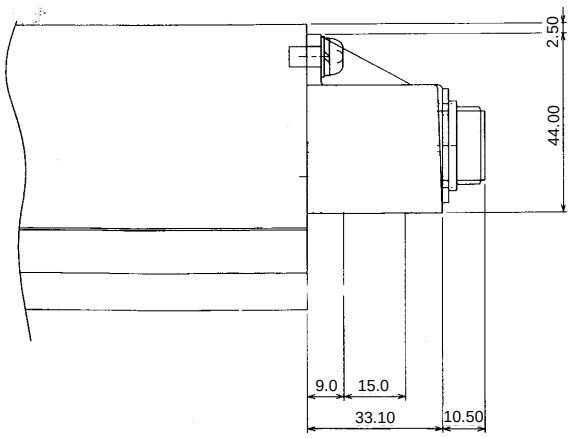
(1) For LM-NP2 type linear motor



(2) For LM-NP4 type linear motor

* View from side (Same for both linear motor types.)





Chapter 7 Installation

⚠ CAUTION

1. The linear servo system uses a powerful magnet on the secondary side. Thus, caution must be taken not only by the person installing the linear motor, but also the machine operators. For example, persons wearing a pacemaker, etc., must not approach the machine.
2. The person installing the linear motor and the machine operator must not have any items (watch or calculator, etc.) which could malfunction or break due to the magnetic force on their body.
3. Always use nonmagnetic tools for installing the linear motor or during work in the vicinity of the linear motor.
   (Example of nonmagnetic tool)
   Explosion-proof beryllium copper alloy safety tool: Nihon Gaishi
4. Install the servo amplifier or motor on noncombustible material. Direct installation on combustible material or near combustible materials could lead to fires.
5. Follow this Instruction Manual and install the unit in a place where the weight can be borne.
6. Do not get on top of or place heavy objects on the unit.
   Failure to observe this could lead to injuries.
7. Always use the unit within the designated environment conditions.
8. The servo amplifier and linear servomotor are precision devices, so do not drop them or apply strong impacts to them.
9. Do not install or run a servo amplifier or linear servomotor that is damaged or missing parts.
10. When storing for a long time, please contact your dealer.

7-1 Installation of the linear servomotor

⚠ CAUTION

1. Securely fix the linear servomotor onto the machine. Incomplete fixing could cause the servomotor to come off during operation, and lead to injuries.
2. The motor must be replaced when damaged. (The connectors, cooling ports, etc., cannot be repaired or replaced.)
3. Use nonmagnetic tools during installation.
4. An attraction force is generated in the magnetic body by the secondary side permanent magnet. Take care not to catch hands.
   Take special care when installing the primary side after the secondary side.
5. Install the counterbalance and holding brakes for the vertical axis on the machine side. The balance weight cannot track at 9.8m/s^2 or more, so use a pneumatic counterbalance, etc., having high trackability.
6. Always install an electrical and mechanical stopper at the stroke end.
7. Take measure to prevent iron-based cutting chips from being attracted to the secondary side permanent magnet.
8. Oil-proofing and dust-proofing measures higher than for the motor must be taken for the linear scale.

POINT

1. Make the machine's rigidity as high as possible.
2. Keep the moving sections as light as possible, and the base section as heavy and rigid as possible.
3. Securely fix the base section onto the foundation with anchor bolts.
4. Keep the primary resonance frequency of the entire machine as high as possible. (Should be 200Hz or more.)
5. Install the motor so that the thrust is applied on the center of the moving sections. If the force is not applied on the center of the moving parts, a moment will be generated.
6. Use an effective cooling method such as circulated cooling oil.
7. In consideration of the cooling properties, select a motor capacity that matches the working conditions.
8. Create a mechanism that can withstand high speeds and high acceleration/deceleration.

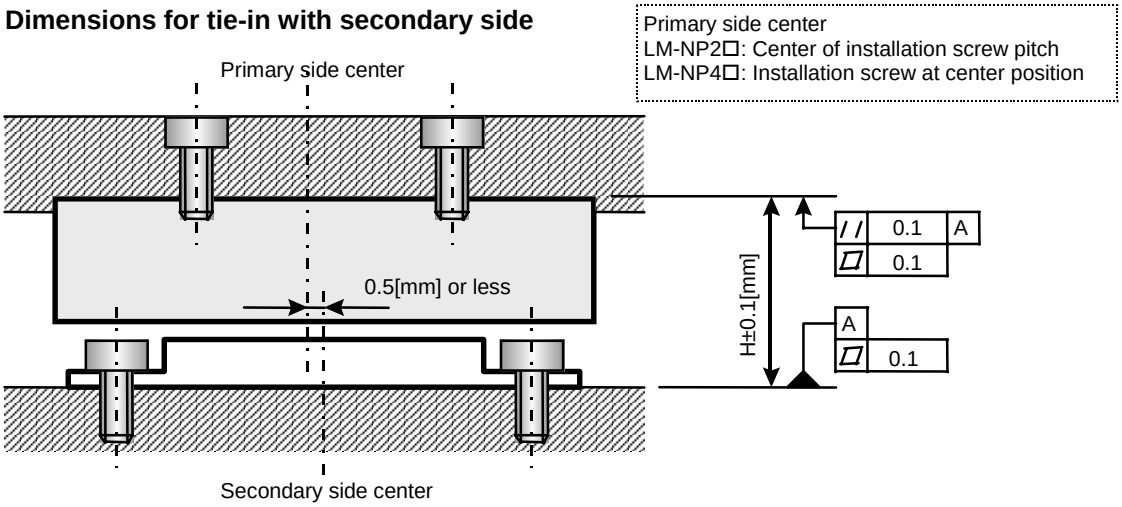
7-1-1 Environmental conditions

Environment	Conditions
Ambient temperature	0°C to +40°C (with no freezing)
Ambient humidity	80% (RH) or less (with no dew condensation)
Storage temperature	–15°C to +50°C (with no freezing)
Storage humidity	90% (RH) or less (with no dew condensation)
Atmosphere	Indoors (Where unit is not subject to direct sunlight) With no corrosive gas, combustible gas or dust
Vibration	49m/s^2 or less

7-1-2 Installing the linear servomotor

(1) Installing the primary side

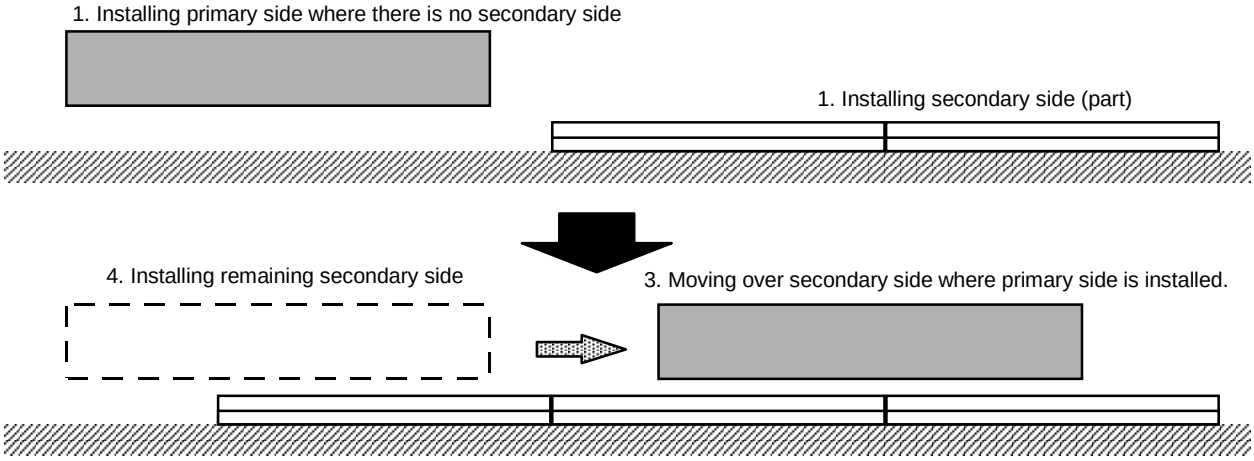
1) Dimensions for tie-in with secondary side



∗1. The H dimensions indicate the (primary side height dimensions) + (secondary side height dimensions) + (clearance length: 0.5[mm]).

2) Example of the installation procedures

An example of the installation procedures is shown below.



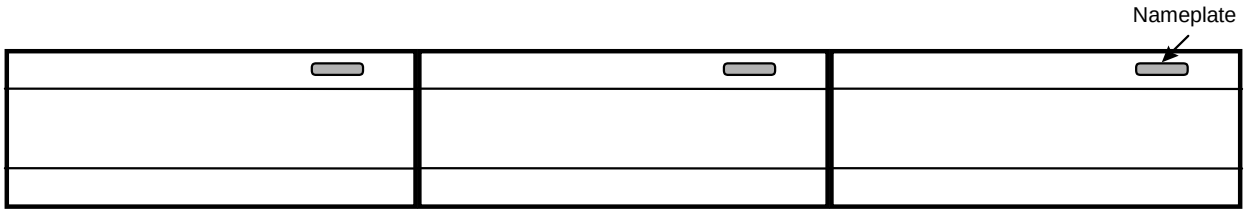
⚠ CAUTION

1. Installing the primary side where there is no secondary side, as shown above, is recommended to avoid risks posed by the attraction force of the permanent magnet between the primary side and secondary side.
2. If the primary side must be installed over the secondary side, use a material handling device, such as a crane, which can sufficiently withstand the load such as the attraction force.
3. Note that an attraction force will be generated even after the primary side has been installed and is moved over to the secondary side.

(2) Installation of secondary side

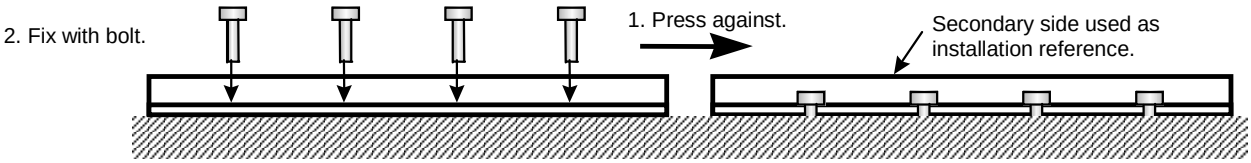
1) Direction

When using multiple secondary sides, lay the units out so that the nameplates on the products all face the same direction in order to maintain the pole arrangement.



2) Procedures

Install with the following procedure to eliminate clearances between the secondary sides.



⚠ CAUTION

1. Use nonmagnetic tools when installing the secondary side.
2. When placing the secondary side onto the installation surface, use the screws on the product, and suspend with eye bolts, etc.
3. If the secondary side is already installed and another secondary side is being added, place the secondary side away from the side already installed, and then slide the additional secondary side to the specific position.

7-1-3 Cooling of linear servomotor

(1) A cooling pipe is embedded on the primary side of the linear motor, so flow at least 5 liters of cooling oil per minute.

(2) When using with natural cooling, the continuous rating will be 50% compared to when using cooling oil.

7-2 Installation of the servo amplifier

⚠ CAUTION

1. Always observe the installation directions. Failure to observe this could lead to faults.
2. Secure the specified distance between the servo amplifier and control panel, or between the servo amplifier and other devices. Failure to observe this could lead to faults.
3. Do not let conductive objects such as screws or metal chips, etc., or combustible materials such as oil enter the servo amplifier or servomotor.
4. Do not block the servo amplifier intake and outtake ports. Doing so could lead to failure.

7-2-1 Environmental conditions

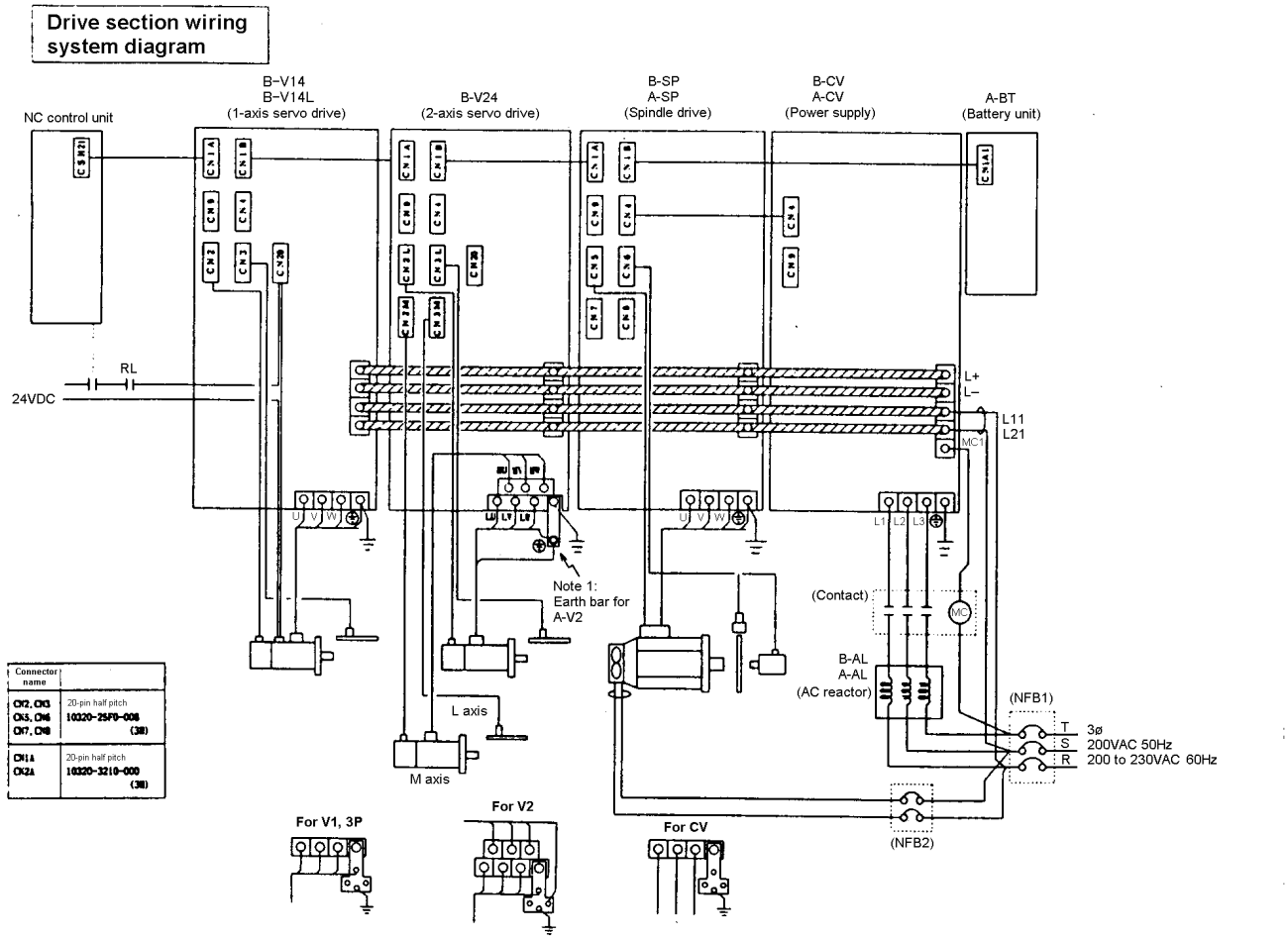
Environment	Conditions
Ambient temperature	0°C to +55°C (with no freezing)
Ambient humidity	90% (RH) or less (with no dew condensation)
Storage temperature	–15°C to +70°C (with no freezing)
Storage humidity	90% (RH) or less (with no dew condensation)
Atmosphere	Indoors (Where unit is not subject to direct sunlight) With no corrosive gas, combustible gas, oil mist or dust
Altitude	1000m or less above sea level
Vibration	5.9m/s^2 or less

⚠ CAUTION

1. The ambient temperature condition for the servo amplifier is 55°C or less. Because heat can easily accumulate in the upper portion of the amplifier, give sufficient consideration to heat dissipation when designing the power distribution panel. If required, install a fan in the power distribution panel to agitate the heat in the upper portion of the amplifier.
2. If a servo amplifier fault should occur, turn OFF the power on the servo amplifier's power supply side.
3. Shut off the power with the error signal. Failure to do so could cause the regenerative resistor to abnormally overheat and fires to occur due to faults in the regenerative transistor, etc.
4. Always install the MDS-B-CV-370 external contactor. Do not use the external contactor with other CV power supply units. Failure to observe this could lead to damage.
5. The MDS-B-V14L-110/150 do not have built-in dynamic brakes. Always use the external dynamic brake unit.

7-2-2 Drive section wiring system diagram

Wire the power supply and main circuit as shown below. Always use a no-fuse breaker (NF) on the power supply input wire.



Note 1: Each unit is provided with an earth bar. Do not tighten the grounding bar together with the other wires. Instead, wires as shown on the right.

Note 2: If there are noise-generating devices (contactor, magnetic brakes, relay) near the power supply or drive unit and the drive unit could malfunction, reduce the generated noise by installing a surge killer on the noise-generating device.

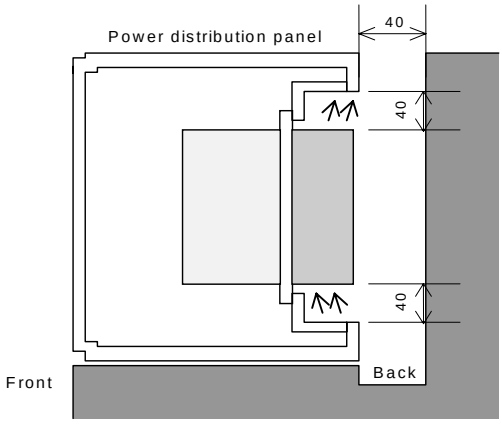
7-2-3 Installing the unit

(1) Each unit is designated to be installed in a cabinet such as a power distribution panel. Avoid installing the unit where it will be subject to direct sunlight, or near heating elements.

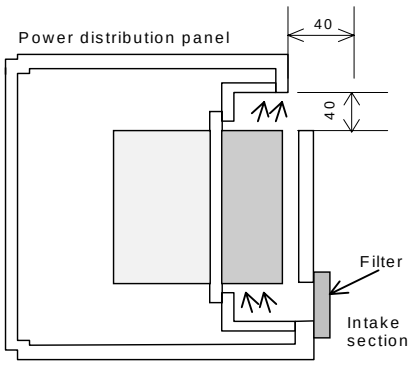
(2) Keep the environmental conditions (temperature, humidity, vibration, atmosphere) in the cabinet within the limits given in the "Specifications for each unit". Always use a sealed structure for the cutting machine cabinet.

(3) Make sure that maintenance, inspections and replacements can be done easily. The space required around each unit is indicated in the outline dimension drawings.

(4) Each unit generates a set amount of heat. Thus, install the other devices and parts with a space to the top and bottom so that heat does not accumulate. Refer to the outline drawing for the rectangular hole dimensions. In this case, place packing between the power distribution panel and unit. Refer to the following installation example for installing the servo amplifier.



Example 1.
Secure an air ventilation area when the machine surface is behind the power distribution panel.



Example 2.
When the outside air cooling section is protruding outside the power distribution panel, make sure that cutting chips will not enter the discharge section.

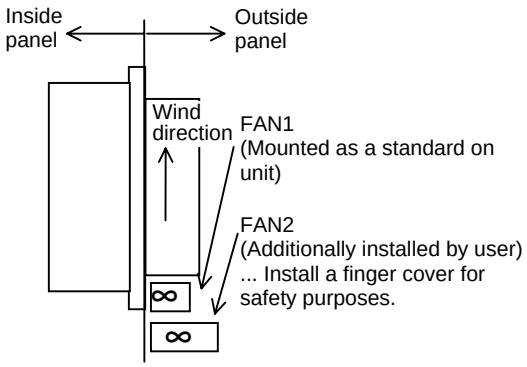
⚠ CAUTION

1. Install a filter on the intake section when installing in a poor environment (factory with high levels of oil mist, etc.).
2. When assembling the control panel, make sure that the cutting chips from the drill, etc., do not enter the amplifier.
3. Make sure that oil, water and metal cutting chips do not enter the amplifier from the clearances of the control panel or the ceiling fan.
4. When using the unit in a place containing toxic gas or high levels of dust, protect the amplifier with air purging (feed clean air from outside to increase the storage panel's inner pressure above the outer pressure and prevent the entry of toxic gas and dust).

(5) Installing the cooling fan

1) Each unit (excluding type without fins) is provided with a cooling fan (FAN1 below). However, to maintain operation when the fan stops due to deterioration of the fan's ambient environment, and to improve the serviceability, the user should install an additional fan (FAN2 below).

When using the sealed type unit installation method and the panel structure could easily allow cutting oil or dust to enter from the unit's fin and fan section (in other words, when the fan could stop due to the ambient environment), the user should add a fan at the position shown as FAN2 on the right. Carry out forced cooling with a velocity of 2m/s or more. The serviceability must also be considered in this case.

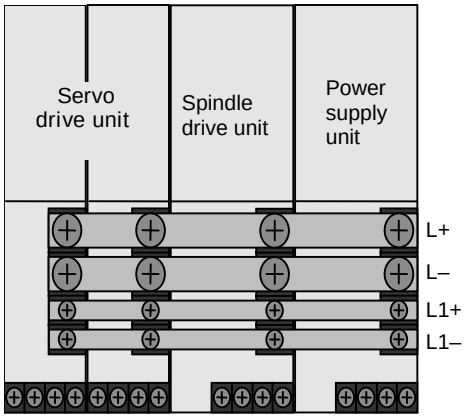


2) Due to the structure, heat will easily accumulate in each unit. Thus, install a fan in the power distribution panel to agitate the heat at the top of the unit.

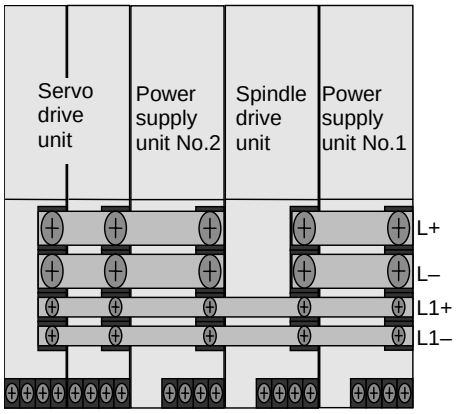
7-2-4 Layout of each unit

Principally, the following layout is used as the standard.

1) When total of spindle motor output and servomotor output is 38kW or less



2) When total of spindle motor output and servomotor output is 38kW or more



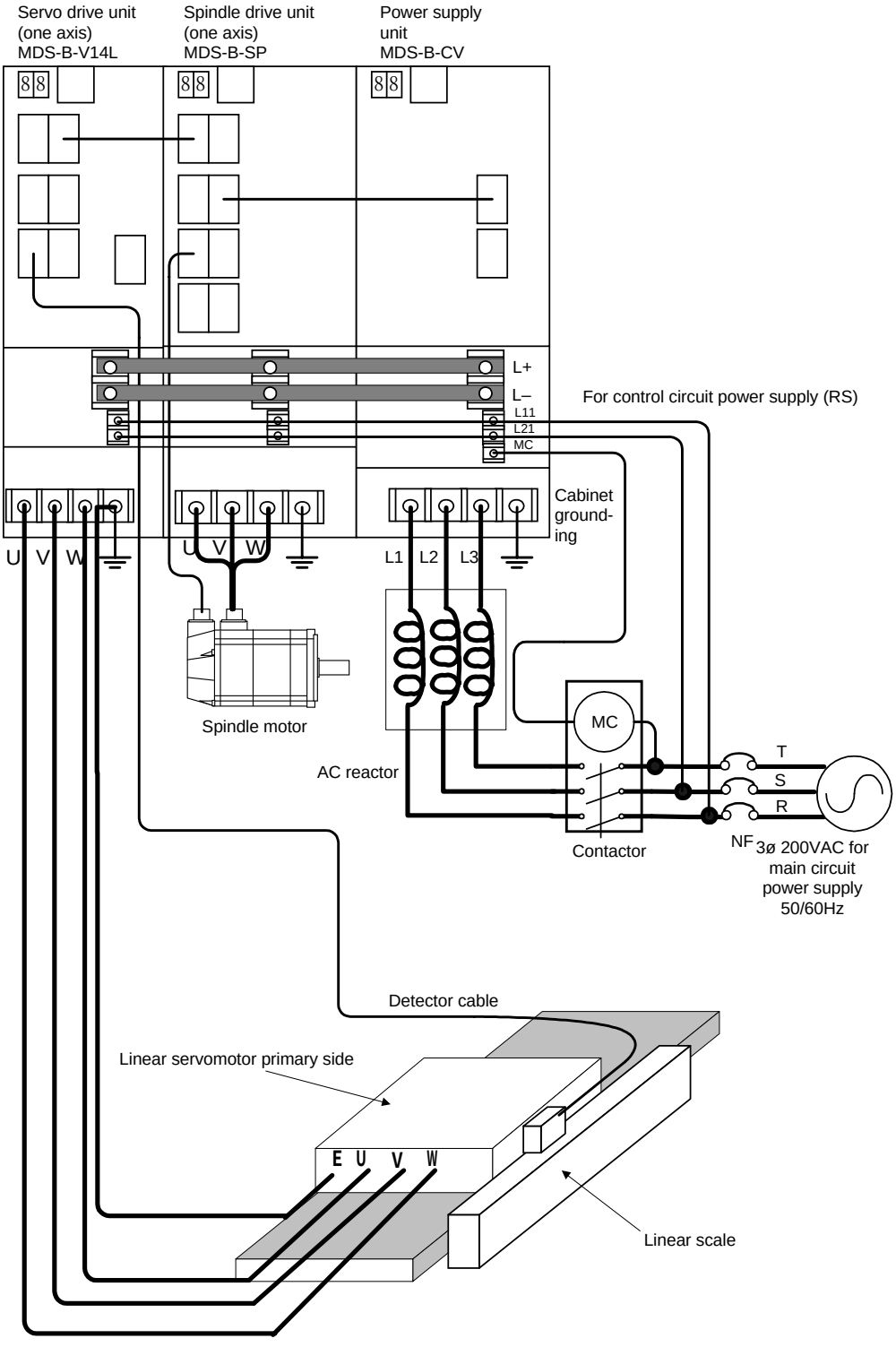
⚠ CAUTION Always connect the L+ and L– link bars of power supply No. 1 and No. 2 independently.

(Note) As a principle, keep the clearance between each unit at 3cm or less.
If the clearance between the spindle drive unit and servo drive unit must be 3cm or more, observe the conditions given in section 7-2-8.

7-2-5 Main circuit connection

⚠ CAUTION

1. Always provide Class 3 grounding or higher for the servo drive unit and servomotor.
2. Correctly connect the power phases (U, V, W) of the servo drive unit and servomotor. Failure to do so could cause the servomotor to abnormally operation.
3. Do not apply a non-designated voltage on each terminal. Failure to observe this could lead to ruptures or trouble.



Precautions for connections

(1) Each unit is provided with an earth bar. Do not tighten the grounding bar together with the other wires.

(2) The wires and crimp terminals used differ according to the motor capacity.

(3) Always ground the power supply.

(4) The phase order of the power supply's power terminals (L1, L2, L3) is random.

(5) Always observe the phase order relation of the servo drive terminals U, V, W and the linear motor terminals U, V, W.
If the phase order is mistaken, the motor could vibrate or move suddenly.

(6) Never connect wires that could apply power to the servo drive output terminals U, V, W. The servo drive unit could be damaged.

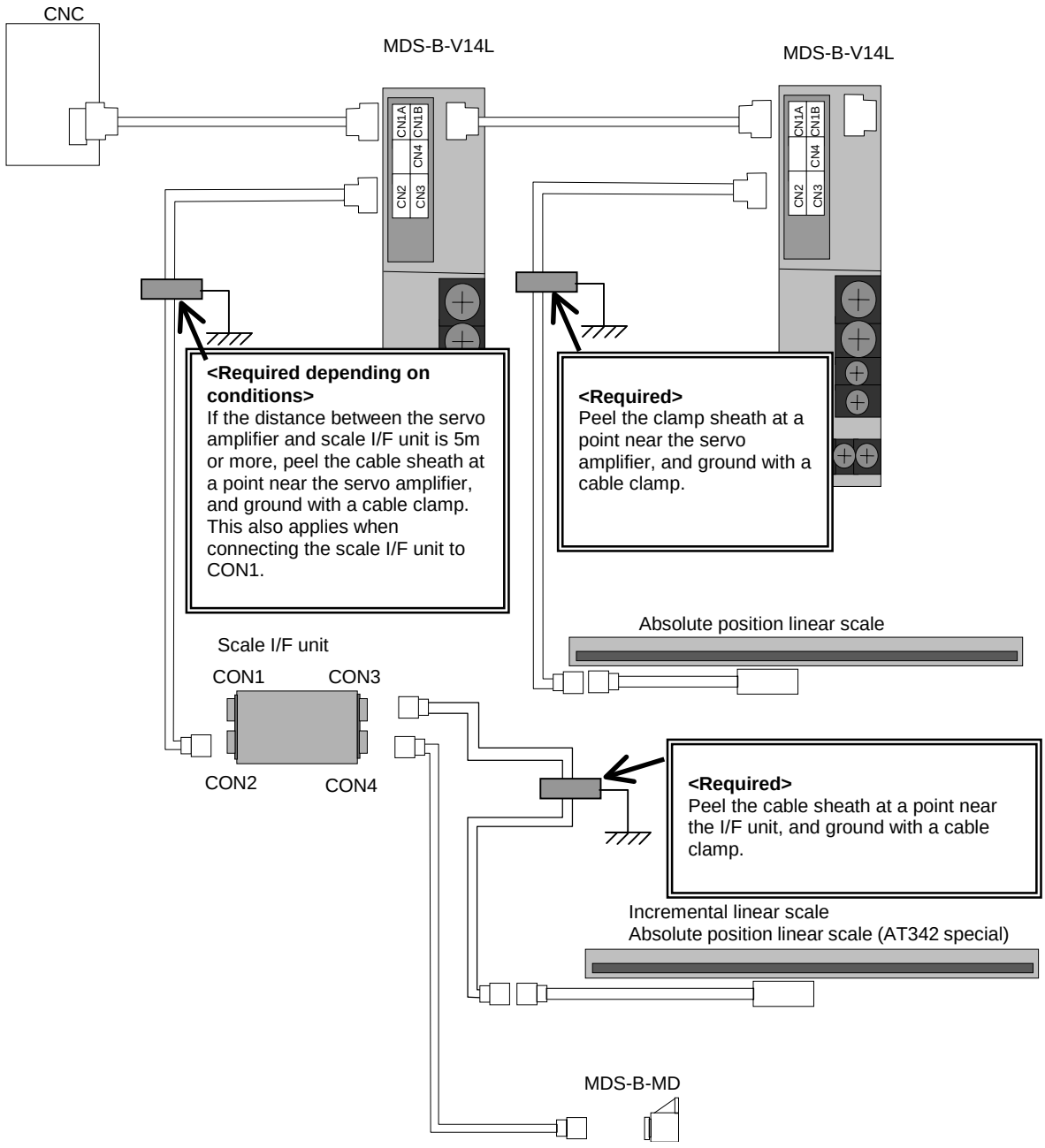
(7) The cannon plug used differs according to the motor. Confirm that the specified power is connected to the servo drive's power terminals (L1+, L2+). Use a transformer if the power is not as specified.

(8) Do not apply a commercial power supply onto the motor.

(9) Refer to the connection diagram and confirm that the wiring is correct.

7-2-6 Connection of feedback cable

Peel the sheath of the feedback cable where indicated below to expose the shield cover. Ground this section with a cable clamp, etc. Normally, only the cable to which the scale is connected is grounded on the servo amplifier side or I/F unit side. However, if the distance between the servo amplifier and scale I/F unit is 5m or more, also ground this cable.

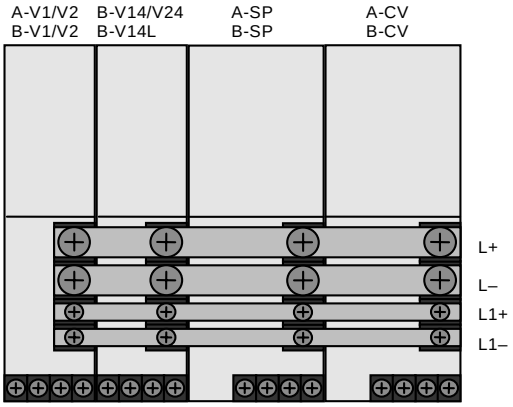


7-2-7 Link bar specifications

The link bar specifications are shown below.

	Wire usage	Terminal block	Details
L+, L–	Not possible	M6 screw	Connection wire for supplying the converter DC voltage from the power supply unit to each drive unit.
L1+, L1–	Possible	M4 screw	Connection wire for supplying control power 200VAC to 230V to each unit.

<Remarks> Connection outline diagram



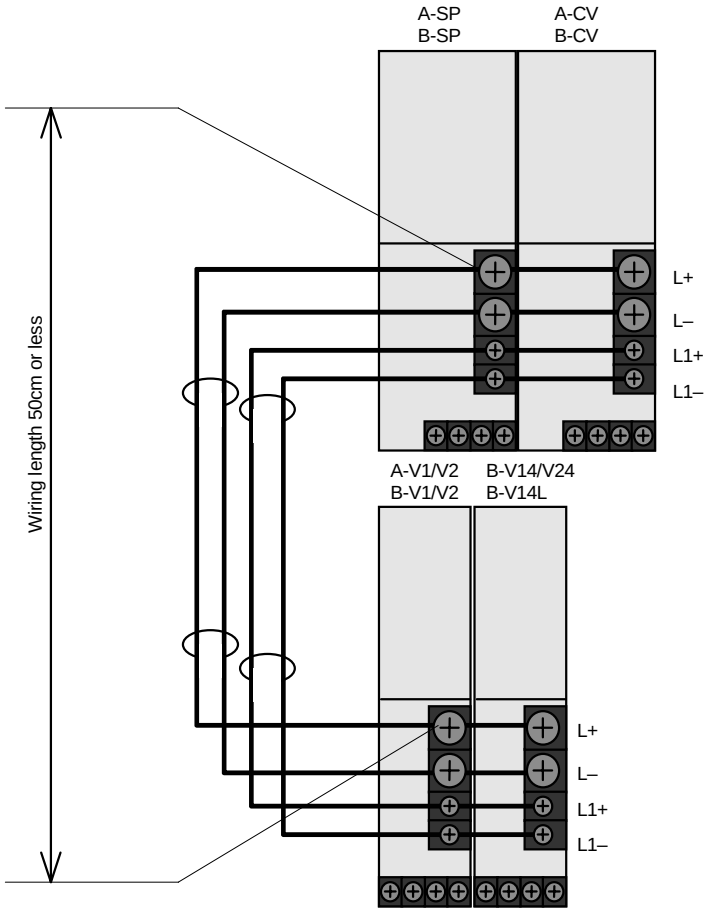
Note) Mount the terminal cover after completing the wiring shown on the left. The terminal cover is provided for each unit width. Refer to "Chapter 3 Selection" when selecting the wire size.

7-2-8 Separated layout of units

When installing the units vertically, avoid separating the MDS-B-V14L linear scale compatible drive unit and power supply unit (A/B-CV), and the spindle drive unit (A/B-SP) and power supply unit (A/B-CV). In the same manner, do not separate the 11kW or more standard servo drive unit (MDS-B-V1).
If both a spindle drive unit and 11kW or more standard drive unit (MDS-B-V1, V14L) are being used, lay out the units and power supply unit with the following priority.

V1 (V14L) – 150 > V1 (V14L) – 110 > SP – 300> SP – 260> SP – 220> SP – 185> SP – 150> ・・・

As shown in the following example, the 9kW or less standard servo drive unit (MDS-B-V1/V2/V14/V24/V14L) can be installed vertically. However, the length of the relay link bar must be 50cm or less, and two bars must be bundled.

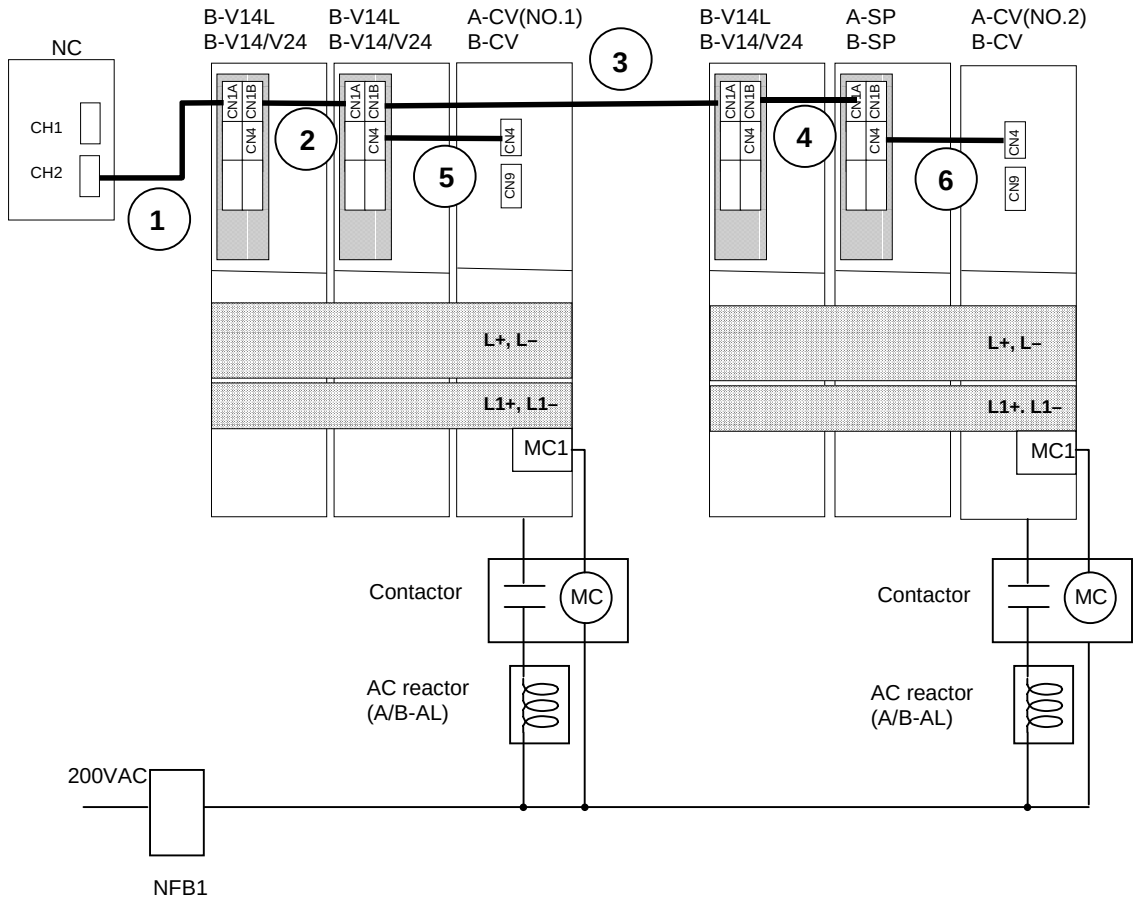


(Note) The above details also apply when separately installing the units to the left and right.

7-2-9 Installing multiple power supply units

(1) When not sharing a contactor

The following system will be explained here as a main example of installing multiple power supply units without sharing a contactor. This same connection is used in other systems using multiple supply units.



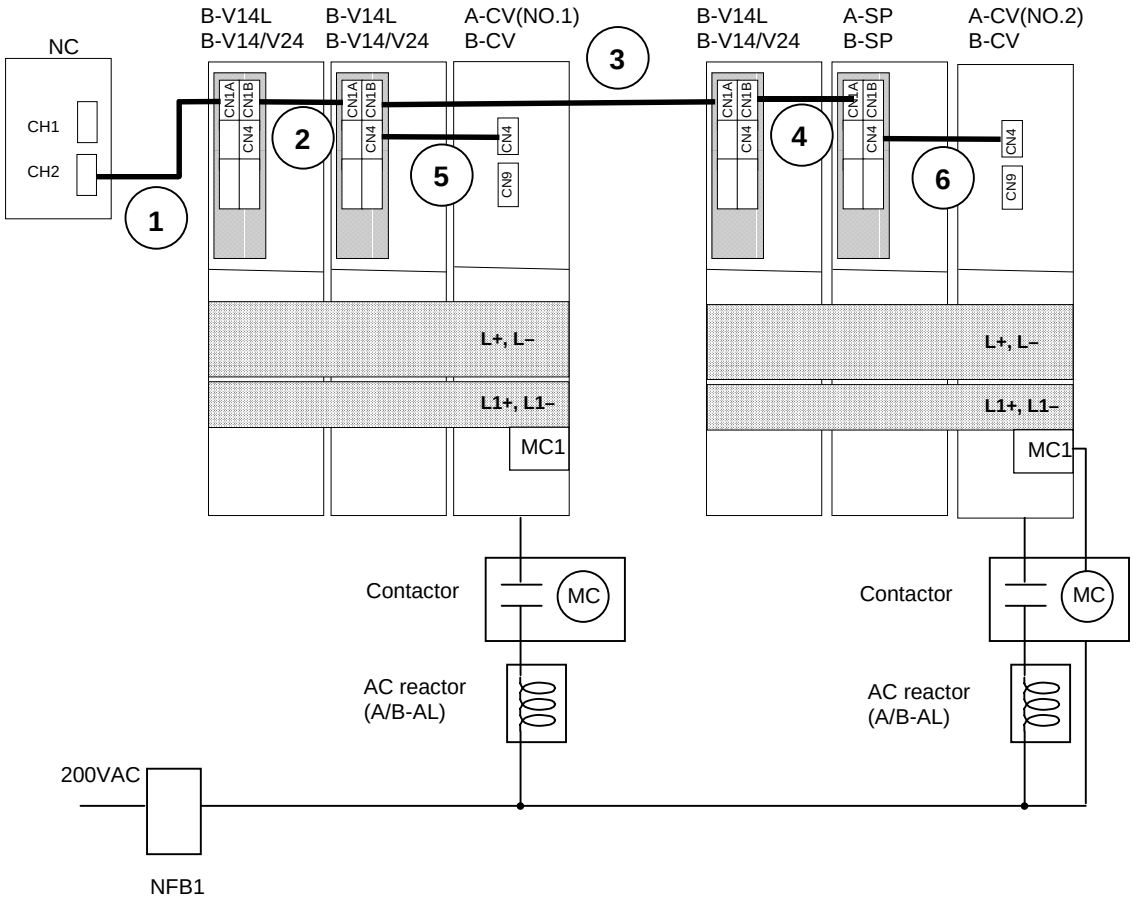
⚠ CAUTION

Always use this wiring when using the MDS-B-CV-370.
The MDS-B-CV-370 has a different rush circuit and contactor operation sequence from the other power supply units (A/B-CV), so the contactor must be installed independently. The unit could be damaged if the contactor is omitted, or if the contactor is shared with other power supply units.

1. Connection of CNC communication cable
   Connect with the ① to ④ line shown above.
2. Connection of communication cable between drive unit and power supply unit
   As shown above, connect the ⑤ cable to power supply unit No. 1 and the ⑥ cable to power supply unit No. 2.
3. Connection of L+, L–, L1+, L1–
   As shown above, connect the link bar for the power supply unit No. 1 and power supply unit No. 2 independently. Do not short circuit both link bars and connect.
4. Connection of AC reactor
   Independently install one AC reactor for each power supply unit.
5. Connection of contactor
   When using the MDS-B-CV-370, the contactors cannot be shared, so install each independently as shown above.

(1) When not sharing a contactor

The following system will be explained here as a main example of installing multiple power supply units sharing one contactor. This same connection is used in other systems using multiple supply units.
When the contactor is shared, set the power supply unit on the side where the contactor is not controlled as "no contactor". In this case, some alarms (ground fault, external contactor fusing) will be invalidated.

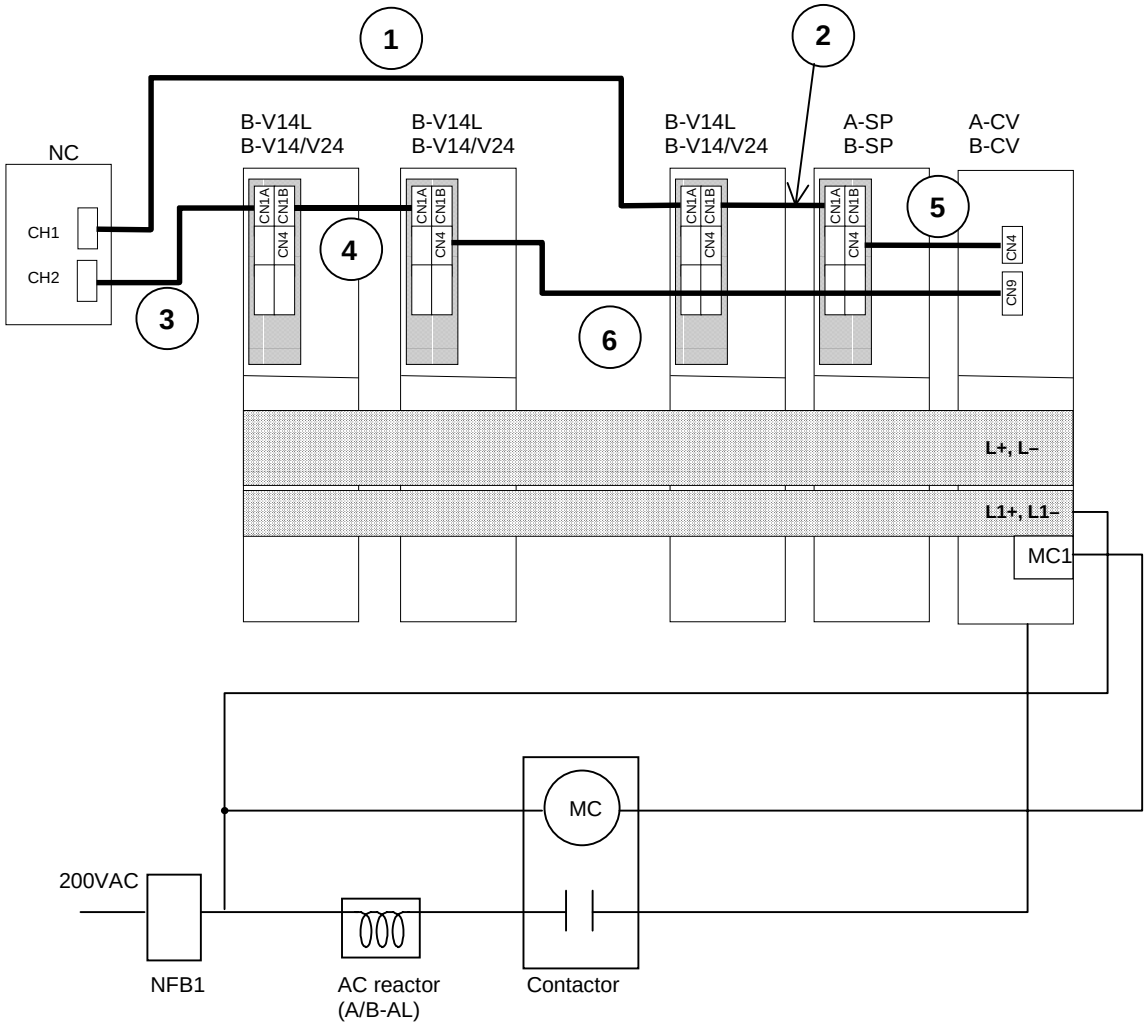


1. Connection of contactor and AC reactor
   As shown above, control is possible by using one contactor in a batch for the power supply unit No. 1 and power supply unit No. 2. Note that one AC reactor must be installed for each power supply unit.
2. Connection of MC1 terminal (power supply unit)
   When controlling multiple power supply units with a batch contactor, connect the contactor coil excitation terminal (MC1) only to the power supply unit (A/B-CV (No. 1) in drawing) connected to the last axis.

7-2-10 Installation for 2ch communication specifications with CNC, and installation of only one power supply unit. (2-system control)

In this example, the following systems are explained. The same connection is used for other 2ch systems.

- CH1: B-V14/V24/V14L + B-V14/V24/V14L
- CH2: B-V14/V24/V14L + A/B-SP



(1) Connection of CNC communication cable

1. CH1
   Connect with the ① to ② line shown above.
2. CH2
   Connect with the ③ to ④ line shown above.

(2) Communication cable between drive unit and power supply unit

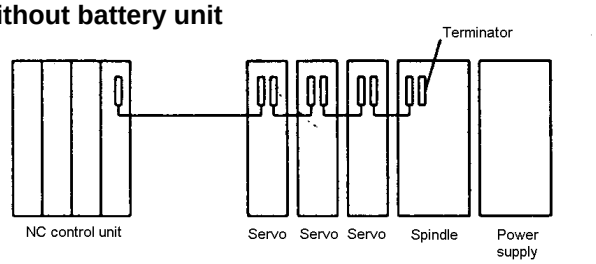
1. CH1
   Connect to the ⑤ line from the CH1 final axis (B-V14/V24/V14L in drawing) as shown above.
2. CH2
   Connect to the ⑥ line from the CH1 final axis (A/B-SP in drawing) as shown above.

Note: The above usage method cannot be used for the MDS-A-CR (regenerative resistor type power supply).

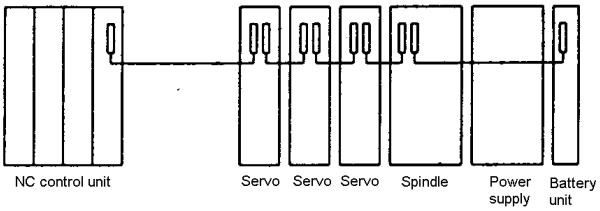
7-2-11 Connection of battery unit

When using the absolute rotary encoder (OSA104, OSA105, etc.) with the linear servo system, the battery unit must be used. When using an absolute linear scale such as LC191M (Heidenhain) or AT342 (Mitsutoyo) with the normal linear servo system, the battery unit is not required.

(1) Without battery unit



(2) With battery unit



The battery unit type is as shown below according to the battery capacity (No. of connected units). Select so that the No. of absolute rotary encoders (OSA104, OSA105) is less than the battery unit capacity.

MDS-A-BT- 2
4
6
8

The last number of the type indicates the battery unit capacity (No. of connected units).

7-2-12 Connection with mechanical brakes

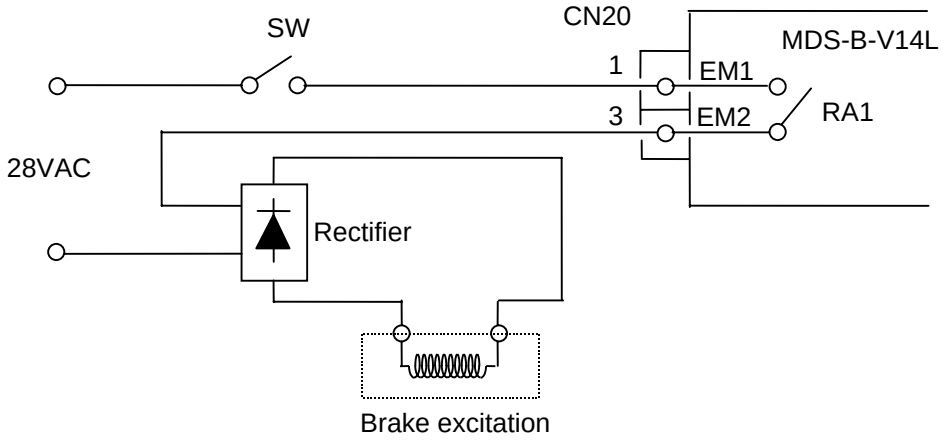
Mechanical brake (magnetic brake) contact connection terminal (EM1, EM2)
A brake terminal is provided on the MDS-B-V14L servo driver. When controlling mechanical brakes using this terminal, connect the magnetic brake cable to the CN20 connector.

(1) Brake contact specifications

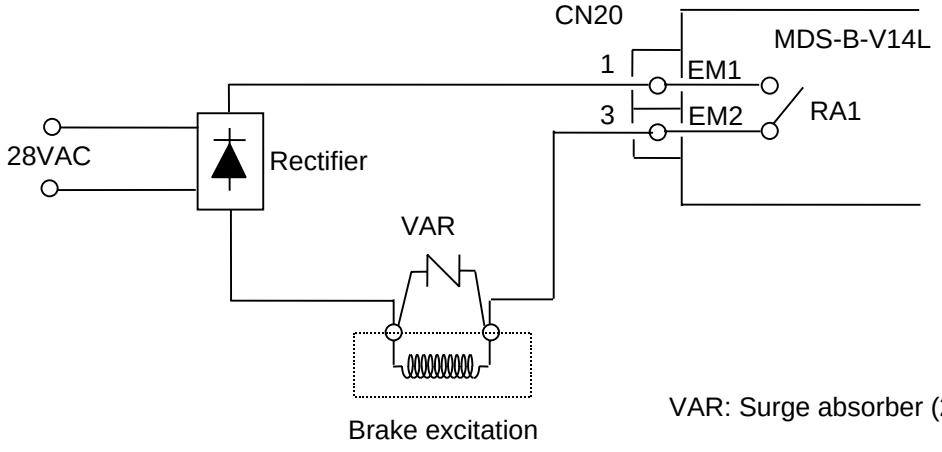
Item	Specifications
Rated control capacity (resistance load)	(AC) 8A 250V/(DC) 5A 30V
Max. tolerable contact power (resistance load)	2000VA 150WA
Max. tolerable contact voltage/current	(AC) 380V/8A

(2) Example of brake contact connection

1) For AC OFF



2) For DC OFF



VAR: Surge absorber (220V)

⚠ CAUTION

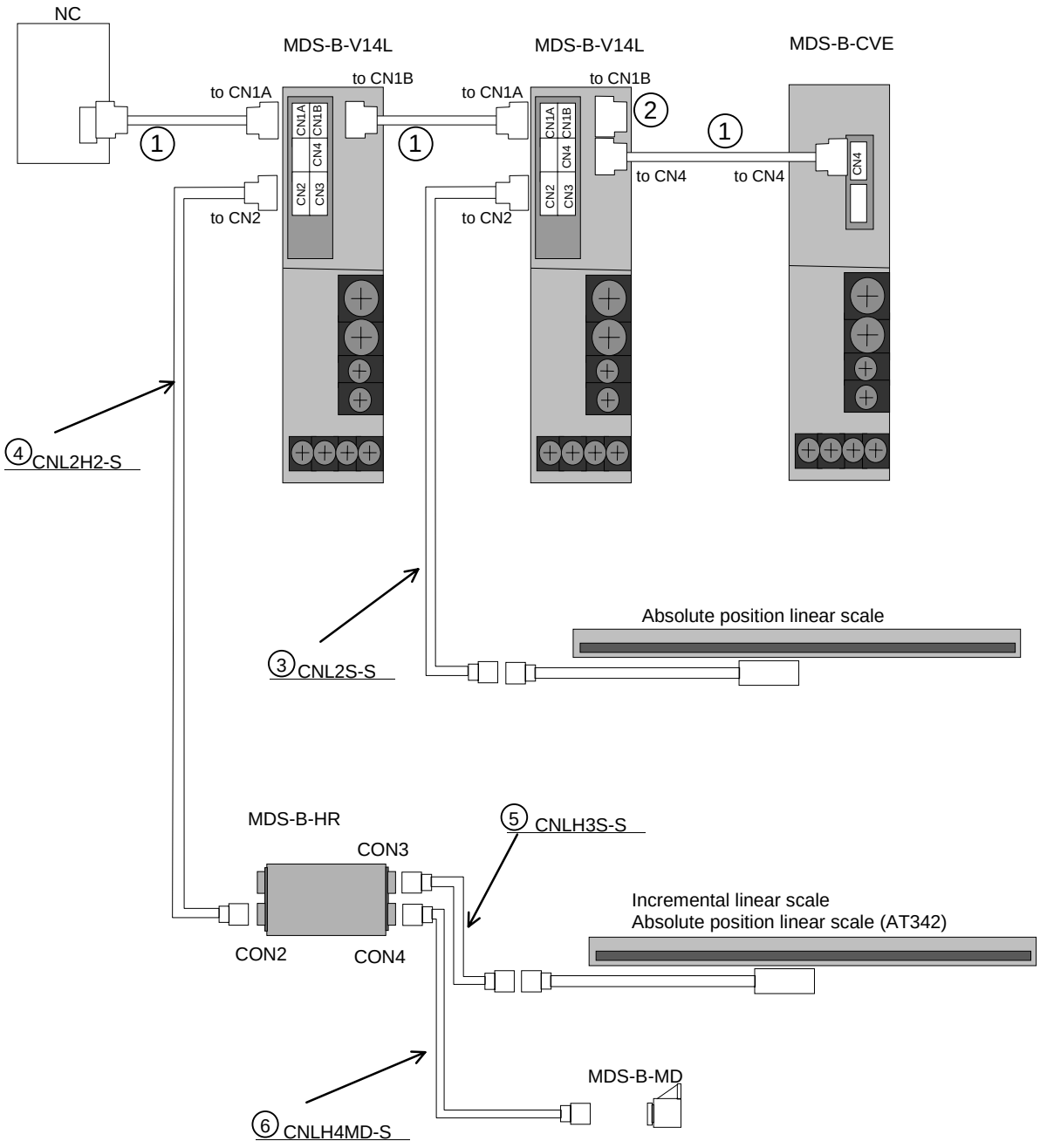
While the DC OFF is valid when the braking delay time is a problem, the contact's DC shut off capacity and the occurrence of error signals for CNC must be confirmed.
Observe the following points.

1. Provide sufficient contact DC shut off capacity.
2. Use a surge absorber.

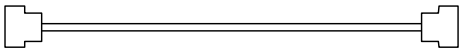
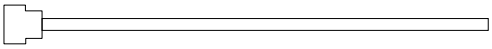
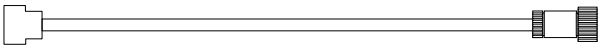
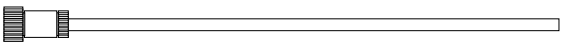
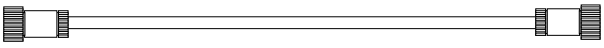
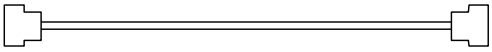
Chapter 8 Drive Section Connector and Cable Specifications

8-1 Cable connection system

The cables and connectors shown below are those that can be ordered from Mitsubishi. Only the cable lengths designated in the table on the next page and following pages can be ordered. If cables with a special length are required, the user should purchase the connector set, etc., and manufacture the cables.



8-1-1 Cable option list

Part name			Type	Descriptions
For CN1A, CN1B, CN4	(1)	Communication cable for CNC unit - Amplifier Amplifier - Amplifier Amplifier - Power supply	SH21 Length: 0.35, 0.5, 0.7, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 6, 7, 8, 9, 10, 15, 20, 30m FCUA-R000 and MR-JHBUS□M can also be used.	Servo amplifier side connector (Sumitomo 3M or equivalent) Connector : 10120-6000EL Shell kit : 10320-3210-000 Servo amplifier side connector (Sumitomo 3M or equivalent) Connector : 10120-6000EL Shell kit : 10320-3210-000 
	(2)	Terminator connector	A-TM FCUA-A-TM can also be used.	Terminator connector 
For CN2, CN3	(3)	Scale coupling cable	CNL2S - □ □ No - One-touch type S - Screw type lock Length: 2, 5, 10, 20, 30m	Servo amplifier side connector (Sumitomo 3M or equivalent) Connector : 10120-3000VE Shell kit : 10320-52F0-008 (One-touch type) 10320-52A0-008 (Screw type) 
	(4)	Cable for amplifier -I/F unit	CNL2H2 - □ □ No - One-touch type S - Screw type lock Length: 2, 5, 10, 20, 30m	Servo amplifier side connector (Sumitomo 3M or equivalent) Connector : 10120-3000VE Shell kit : 10320-52F0-008 (One-touch type) 10320-52A0-008 (Screw type) Interface unit side connector (Hirose) Connector: RM15WTP-8S Clamp: RM15WTP-CP (10) 
For I/F unit	(5)	Cable for I/F unit - scale	CNLH3S Length: 2, 5, 10, 20, 30m	Interface unit side connector (Hirose) Connector: RM15WTP-12P Clamp: RM15WTP-CP (10) 
	(6)	Cable for I/F unit – magnetic pole detector	CNLH4MD Length: 2, 5, 10, 20, 30m	Interface unit side connector (Hirose) Connector: RM15WTP-10P Clamp: RM15WTP-CP (10) Pole detector side connector (Hirose) Connector: RM15WTP-8S Clamp: RM15WTP-CP (10) 
	(7)	Cable for Amplifier - signal branch unit	CNV22A - □ □ No - One-touch type S - Screw type lock Length: 2, 5, 10, 20, 30m	Servo amplifier side (Sumitomo 3M or equivalent)  Connector: 10120-3000VE Shell kit : 10320-52F0-008 (One-touch type) 10320-52A0-008 (Screw type) Connector: 10120-3000VE Shell kit : 10320-52F0-008 (One-touch type) 10320-52A0-008 (Screw type)

Part name				Type	Descriptions
For motor power supply	Power supply connector for LM-NP2S LM-NP2M LM-NP2L	IP67 and EN standard compatible	Straight	PWCE22-23S Compliant cable range ø9.5 to ø13	Servomotor side power supply connector (DDK) Connector : CE05-6A22-23SD-B-BSS Clamp: CE3057-12A-2 (D265) 
			Angle	PWCE22-23L Compliant cable range ø9.5 to ø13	Servomotor side power supply connector (DDK) Connector : CE05-8A22-23SD-B-BAS Clamp: CE3057-12A-2 (D265) 
		For general environment	Straight	FCUA-CN802	Servomotor side power supply connector (DDK) Connector : MS3106B22-23S Clamp: MS3057-12A 
			Angle	FCUA-CN806	Servomotor side power supply connector (DDK) Connector : MS3108B22-23S Clamp: MS3057-12A 
	Power supply connector for LM-NP4S LM-NP4M LM-NP4L	IP67 and EN standard compatible	Straight	PWCE24-10S Compliant cable range ø13 to ø15.5	Servomotor side power supply connector (DDK) Connector : CE05-6A24-10SD-B-BSS Clamp: CE3057-16A-2 (D265) 
			Angle	PWCE24-10L Compliant cable range ø13 to ø15.5	Servomotor side power supply connector (DDK) Connector : CE05-8A24-10SD-B-BAS Clamp: CE3057-16A-2 (D265) 
		For general environment	Straight	FCUA-CN803	Servomotor side power supply connector (DDK) Connector : MS3106B24-10S Clamp: MS3057-16A 
			Angle	FCUA-CN807	Servomotor side power supply connector (DDK) Connector : MS3108B24-10S Clamp: MS3057-16A 
	Power supply connector for LM-NP4G	For general environment	Straight		Servomotor side power supply connector (DDK) Connector : MS3106B32-17S Clamp: MS3057-20A 
			Angle		Servomotor side power supply connector (DDK) Connector : MS3108B32-17S Clamp: MS3057-20A 

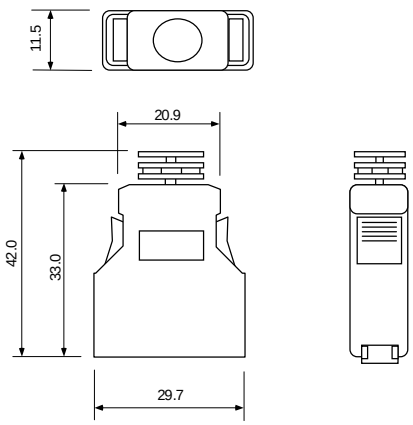
8-2 Cable connectors

8-2-1 Servo amplifier CN1A, CN1B and CN9 cable connector

Maker: Sumitomo 3M
<Type>
Connector: 10120-6000EL
Shell kit: 10320-3210-000

There is no option setting with this connector. This is a part integrally formed with the cable.

[Unit: mm]

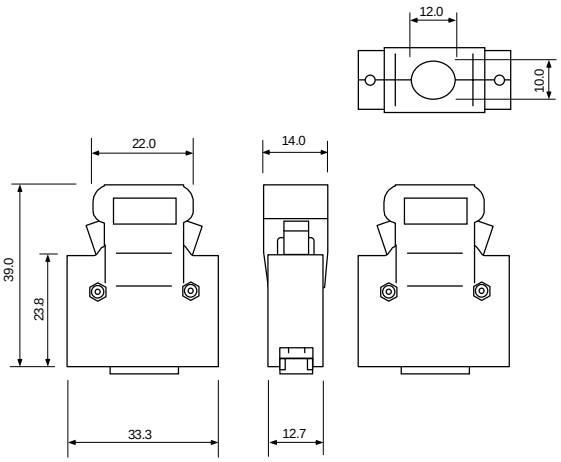


8-2-2 Servo amplifier CN2 and CN3 cable connector

Maker: Sumitomo 3M
<Type>
Connector : 10120-3000VE

Shell kit : 10320-52F0-008
(One-touch type)
10320-52A0-008
(Screw type)

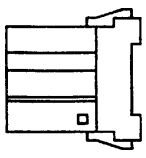
[Unit: mm]



8-2-3 Servo amplifier CN20 connector (for mechanical brakes)

Maker: Sumitomo 3M
<Type>
Connector: 1-178128-3
Contactor : 1-178128-2

[Unit: mm]



8-2-4 MDS-B-HR, MDS-B-MD cable connector

Maker: Hirose [unit:mm]

I/F unit connector

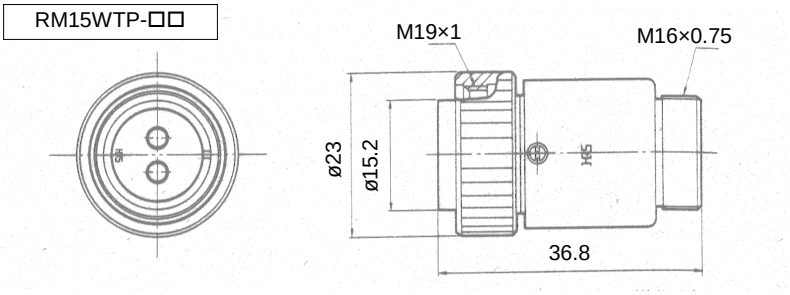
CON1, CON2	RM15WTP-8S
	RM15WTP-CP (□□)
CON3	RM15WTP-12P
	RM15WTP-CP (□□)
CON4	RM15WTP-10P
	RM15WTP-CP (□□)

Pole detector connector

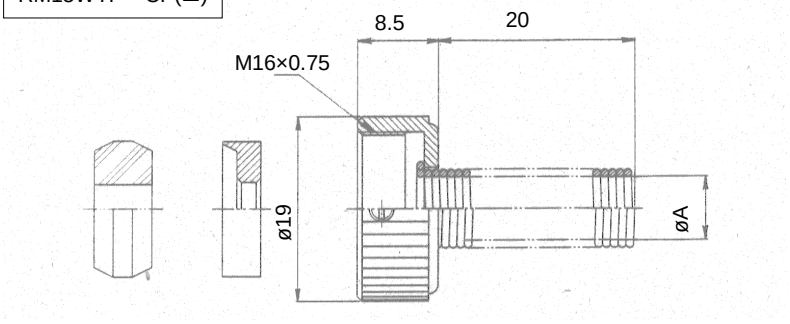
CNM1	RM15WTP-8S
	RM15WTP-CP (□□)

Note: The cable diameter is indicated in □□.

RM15WTP-□□



RM15WTP－CP(□)

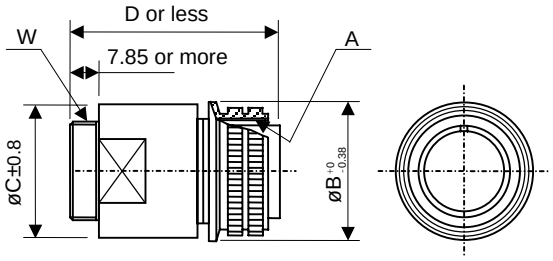


I/F unit connector

Product name	øA	Applicable cable diameter
RM15WTP-CP (5)	6.5	5
RM15WTP-CP (6)	6.5	6
RM15WTP-CP (7)	8	7
RM15WTP-CP (8)	10.5	8
RM15WTP-CP (9)	10.5	9
RM15WTP-CP (10)	10.5	10

8-2-5 Power supply section power wire connector

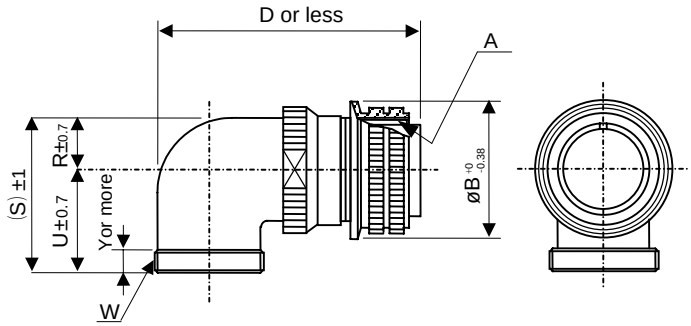
Straight plug
Maker : DDK (Ltd.)



[Unit: mm]

Type	A	B +0 −0.38	C±0.8	D or less	W
CE05-6A22-23SD-B-BSS	$1^{3}/_{8}$-18UNEF-2B	40.48	38.3	61	$1^{3}/_{16}$-18UNEF-2A
CE05-6A24-10SD-B-BSS	$1^{1}/_{2}$-18UNEF-2B	43.63	42.0	68	$1^{7}/_{16}$-18UNEF-2A

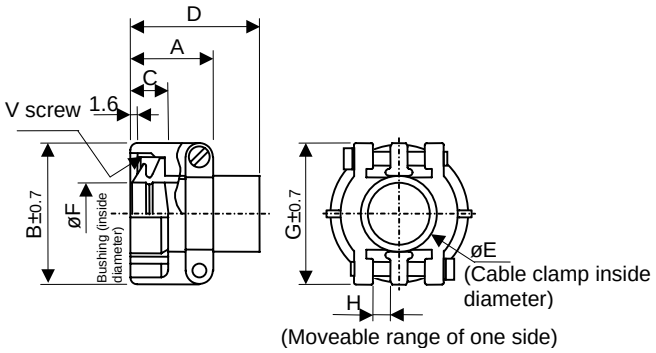
Angle plug
Maker : DDK (Ltd.)



[Unit: mm]

Type	A	B +0 −0.38	D or less	W	R±0.7	U±0.7	(S)±1	Y or more
CE05-8A22-23SD-B-BAS	$1^{3}/_{8}$-18UNEF-2B	40.48	75.5	$1^{3}/_{16}$-18UNEF-2A	16.3	33.3	49.6	7.5
CE05-8A24-10SD-B-BAS	$1^{1}/_{2}$-18UNEF-2B	43.63	86.3	$1^{7}/_{16}$-18UNEF-2A	18.2	36.5	54.7	7.5

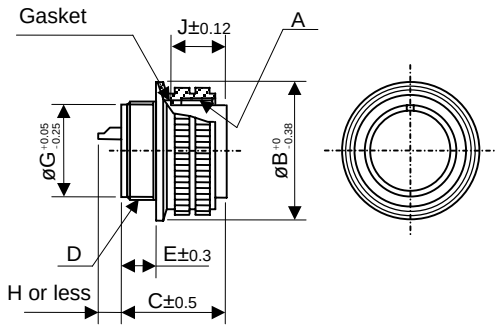
Cable clamp
Maker : DDK (Ltd.)



[Unit:mm]

Type	Shell size	Total length A	Outside dia. B	Effective screw length C	D	E	F	G	H	Installation screws (V)	Bushing	Compliant cable
CE3057-12A-2 (D265)	20, 22	23.8	35	10.3	41.3	19	13	37.3	4	$1^{3}/_{16}$-18UNEF-2B	CE3420-12-2	ø9.5 to ø13
CE3057-12A-3 (D265)							10				CE3420-12-3	ø6.8 to ø10
CE3057-16A-2 (D265)	24	26.2	42.1	10.3	41.3	23.8	15.5	42.9	4.8	$1^{7}/_{16}$-18UNEF-2B	CE3420-16-2	ø13 to ø15.5

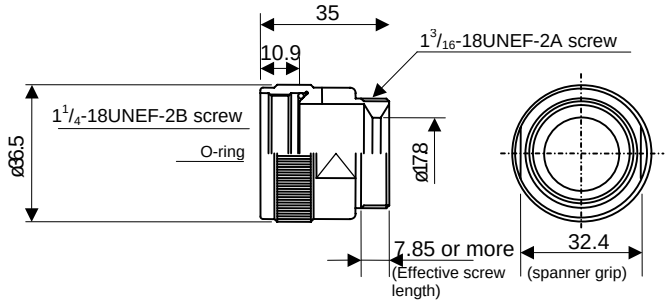
Straight plug
Maker : DDK (Ltd.)



[Unit: mm]

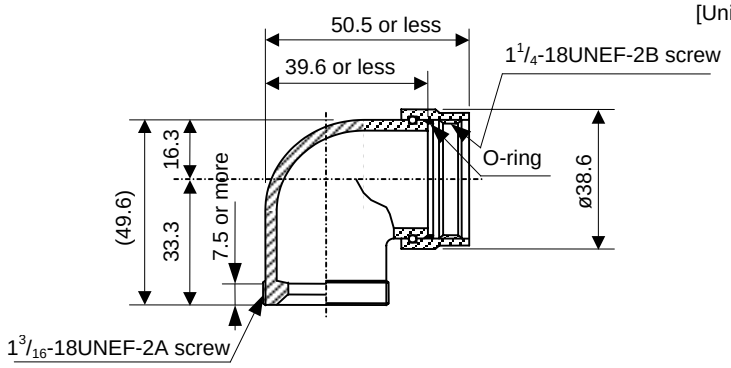
Type	A	B +0 −0.38	C±0.5	D	E±0.3	G +0.05 −0.25	J±0.12
MS3106A10SL-4S (D190)	5/8-24UNEF-2B	22.22	23.3	9/16-24UNEF-2A	7.5	12.5	13.49
MS3106A22-14S (D190)	1 3/8-18UNEF-2B	40.48	34.11	1 1/4-18UNEF-2A	12.15	29.9	18.26

Straight back shell
Maker : DDK (Ltd.)

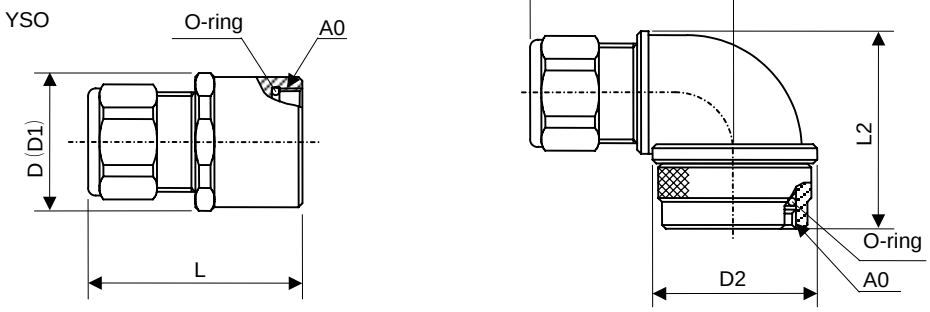


Angle back shell
Maker : DDK (Ltd.)
Type : CE-22BA-S

[Unit:mm]



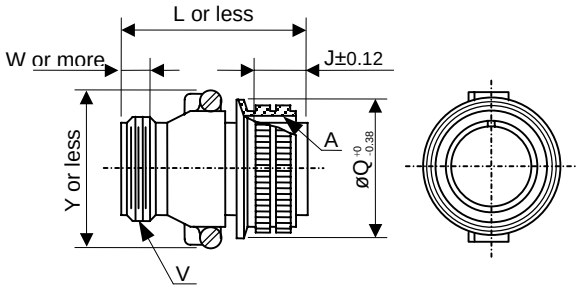
Cable clamp
Maker : Daiwa (Ltd.)



[Unit:mm]

Type	Accommodating outside diameter	American standard screw thread Aø	Length before tightening		L2	Side to side	Corner to corner	
			L	L1		D	D1	D2
YSO10-5 to 8, YLO10-5 to 8	ø5 to 8.3	9/16-24UNEF-2B	43	39	42.5	24	26	26

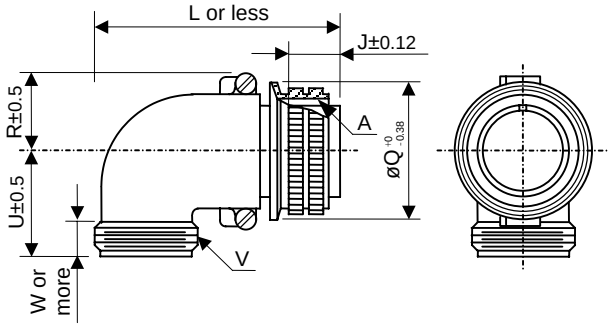
Straight plug
Maker : DDK (Ltd.)



[Unit: mm]

Type	Coupling screw A	Length of coupling section J ± 0.12	Total length L or less	Connection nut outside diameter øQ +0 −0.38	Cable clamp installation screw V	Effective screw length W or more	Max. width Y or less
MS3106B22-23S	$1^{3}/_{8}$-18UNEF	18.26	55.57	40.48	$1^{3}/_{16}$-18UNEF	9.53	50
MS3106B24-10S	$1^{1}/_{2}$-18UNEF	18.26	58.72	43.63	$1^{7}/_{16}$-18UNEF	9.53	53

Angle plug
Maker : DDK (Ltd.)



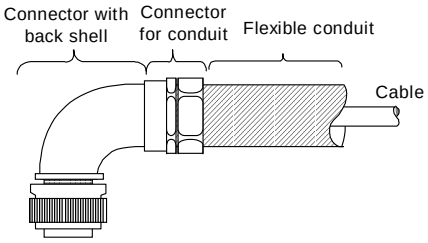
[Unit: mm]

Type	Coupling screw A	Length of coupling section J ± 0.12	Total length L or less	Connec-tion nut outside diameter øQ +0 −0.38	R±0.5	U±0.5	Cable clamp installation screw V	Effective screw length W or more
MS3108B22-23S	$1^{3}/_{8}$-18UNEF	18.26	76.98	40.48	24.1	33.3	$1^{3}/_{16}$-18UNEF	9.53
MS3108B24-10S	$1^{1}/_{2}$-18UNEF	18.26	86.51	43.63	25.6	36.5	$1^{7}/_{16}$-18UNEF	9.53

8-2-6 Flexible conduits

Basically, splash proofing can be ensured if cab-tire cable and connectors with IP65 or higher specifications are used. However, to further improve the oil resistance (chemical resistance to oil), weather resistance (resistance to the environment when used outdoors, etc.), durability, tensile strength, flattening strength, etc., run the cable through a flexible conduit when wiring.
The following shows an example of a flexible conduit. Contact the connector maker for more information.

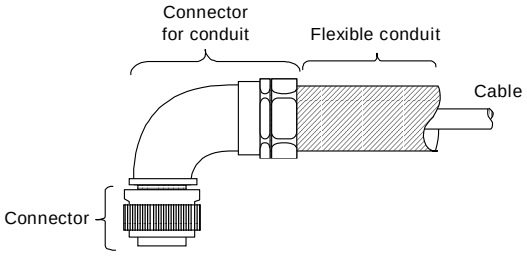
(1) Method for connecting to a connector with back shell



Application	Applicable motors	Type			
		DDK		Japan Flex	
		Connector (straight)	Connector (angle)	Connector for conduit	Flexible conduit
For power supply	For LM-NP2S LM-NP2M LM-NP2L	CE05-6A22-23S D-B-BSS	CE05-8A22-23S D-B-BAS	RCC-104CA2022	VF-04 (Min. inside dia.: 14)
				RCC-106CA2022	VF-06 (Min. inside dia.: 19)
	For LM-NP4S LM-NP4M LM-NP4L	CE05-6A24-10S D-B-BSS	CE05-8A24-10S D-B-BAS	RCC-106CA2428	VF-06 (Min. inside dia.: 19)
				RCC-108CA2428	VF-08 (Min. inside dia.: 24.4)

(Note) None of the parts in this table can be ordered from Mitsubishi Electric Corp.

(2) Method for connecting to the connector main body

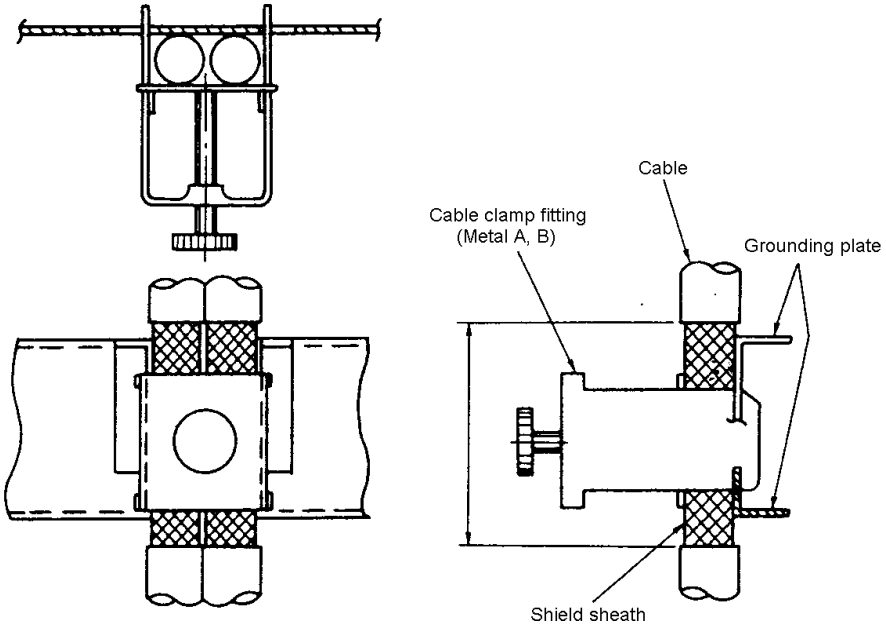


Application	Applicable motors	Type		
		DDK	DAIWA DENGYO Co., Ltd.	
		Connector (straight)	Connector for conduit	Flexible conduit
For power supply	For LM-NP2S LM-NP2M LM-NP2L	CE05-6A22-23SD-B	BOS-22-15 (Straight) BOL-22-15 (Angle)	MPF15 (Min. inside dia.: 14.2)
			BOS-22-19 (Straight) BOS-22-19 (Angle)	MPF19 (Min. inside dia.: 17.2)
	For LM-NP4S LM-NP4M LM-NP4L	CE05-6A24-10SD-B	BOS-24-19 (Straight) BOL-24-19 (Angle)	MPF19 (Min. inside dia.: 17.2)
			BOS-24-25 (Straight) BOL-24-25 (Angle)	MPF25 (Min. inside dia.: 23.5)

(Note) None of the parts in this table can be ordered from Mitsubishi Electric Corp.

8-3 Cable clamp fitting

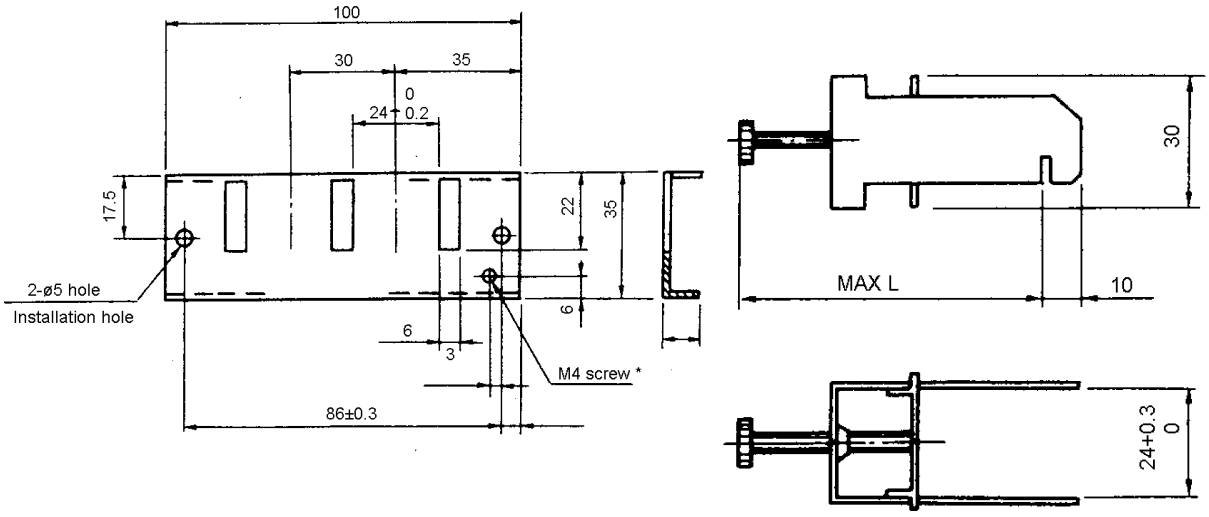
Install a grounding plate near the servo amplifier or scale I/F unit (MDS-B-HR), peel part of the detector cable sheath to expose the shield coat, and press that section against the grounding plate with a cable clamp fitting. If the cable is thin, clamp several together.



Clamp section drawing

The grounding plate D and cable clamp fittings A and B can be purchased from Mitsubishi.

Outline drawing of grounding plate (D) **Outline drawing of cable clamp fitting**



∗ Screw hole for wiring through cabinet to grounding plate

- Always wire the grounding wire from the grounding plate to the cabinet's grounding plate.
- Two fittings A can be used.

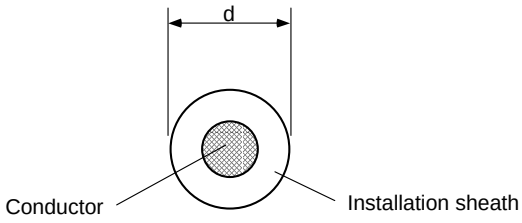
	L
Fitting A	70
Fitting B	45

8-4 Cable wire and assembly

The following shows the specifications and processing of the wire used in each cable. Use the following recommended wires or equivalent part when manufacturing the cable, and make sure not to mistake the connection.

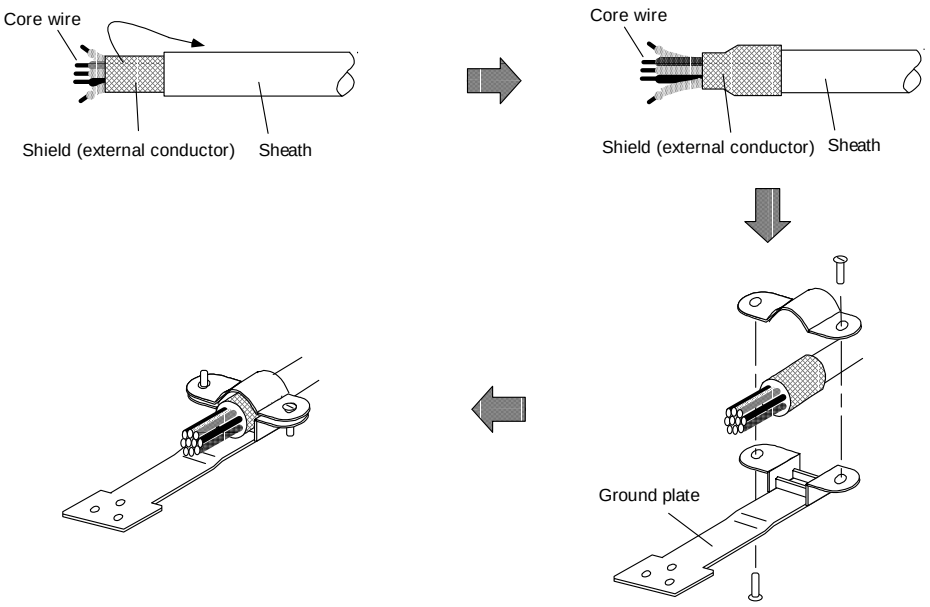
Core size [mm^2] × pair	Core insulation sheath type (Note) d [mm]	Recommended wire type
0.08 × 10	0.9 to 1.27	UL20276 AWG28 10pair (BLACK)
0.2 × 8		UL20276 AWG24 8pair (BLACK)
0.3 × 8		UL20276 AWG22 7pair (BLACK)

(Note) d is as shown below.



Core cross-section

Securely connect the cable shield wire to the connector's ground plate as shown below.



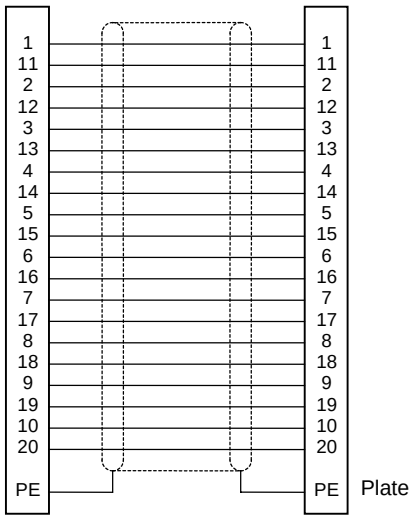
8-5 Cable connection diagram

> **⚠ CAUTION** Do not mistake the connection when manufacturing the detector cable. Failure to observe this could lead to faults, runaway or fires.

8-5-1 CNC unit bus cable

<SH21 cable connection diagram>

This is an actual connection diagram for the SH21 cable supplied by Mitsubishi.
Manufacture the cable as shown below.

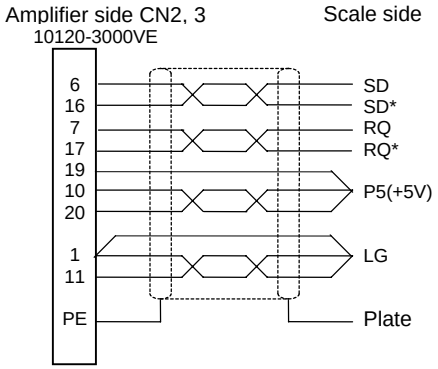


8-5-2 Absolute value scale coupling cable

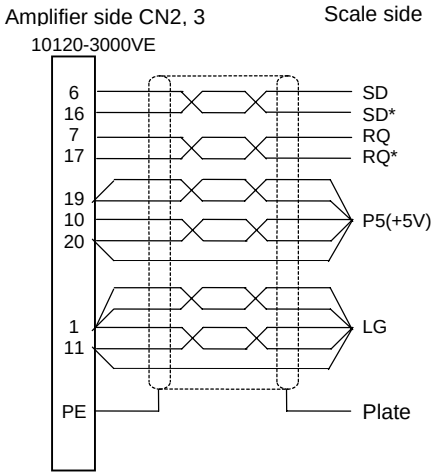
<CNL2S-S cable connection diagram>

This is an actual connection diagram for the CNL2S-S cable supplied by Mitsubishi. The connection differs according to the cable length.

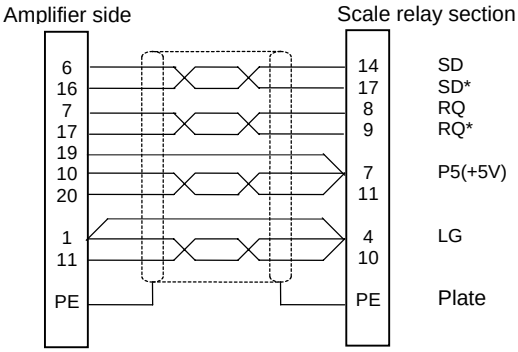
(20m or less)



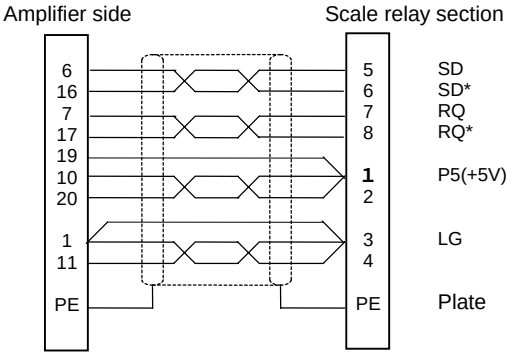
(20 to 30m)



<Reference example 1. LC191M (Heidenhain)>



<Reference example 2. AT342 (Mitsutoyo)>

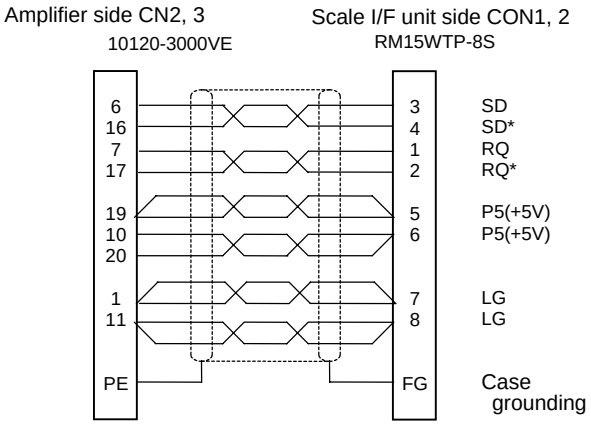


8-5-3 Cable for amplifier – scale I/F unit

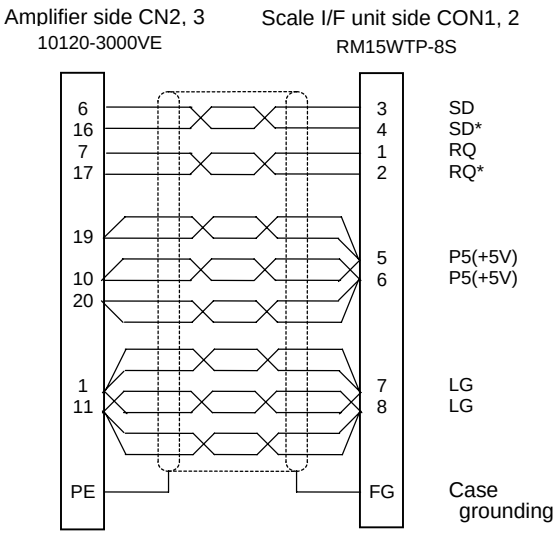
<CNL2H2-S cable connection diagram>

This is an actual connection diagram for the CNL2H2-S cable supplied by Mitsubishi. The connection differs according to the cable length.

(15m or less)



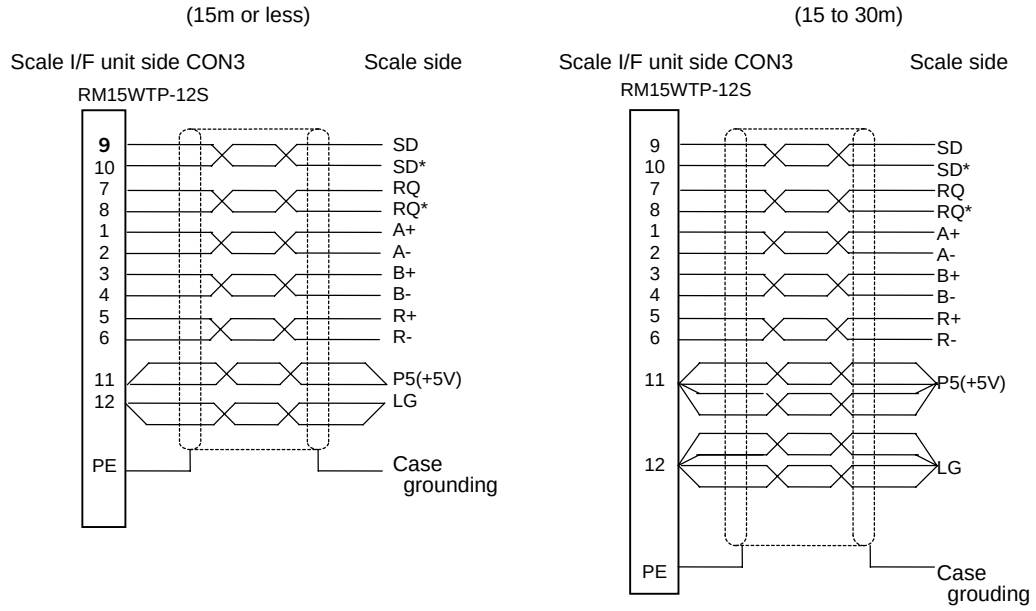
(15 to 30m)



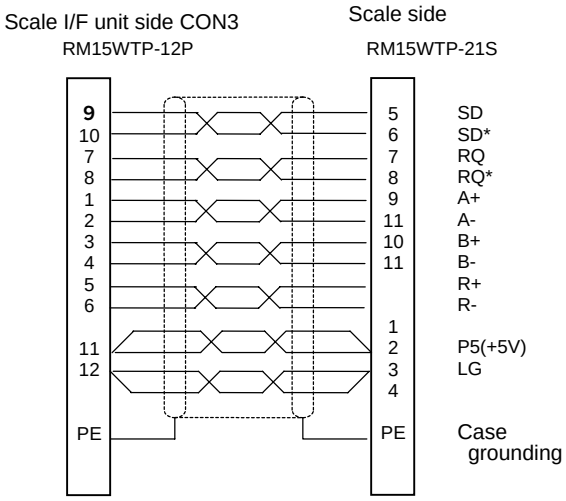
8-5-4 Cable for scale I/F unit – scale

<CNLH3S cable connection diagram>

This is an actual connection diagram for the CNLH3S cable supplied by Mitsubishi. The connection differs according to the cable length.



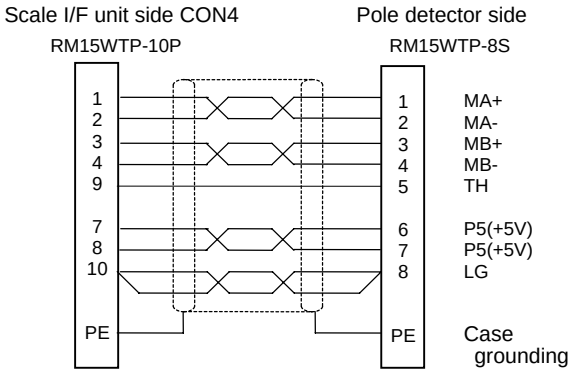
<Reference example 1. AT342 (Mitsutoyo) connection example>



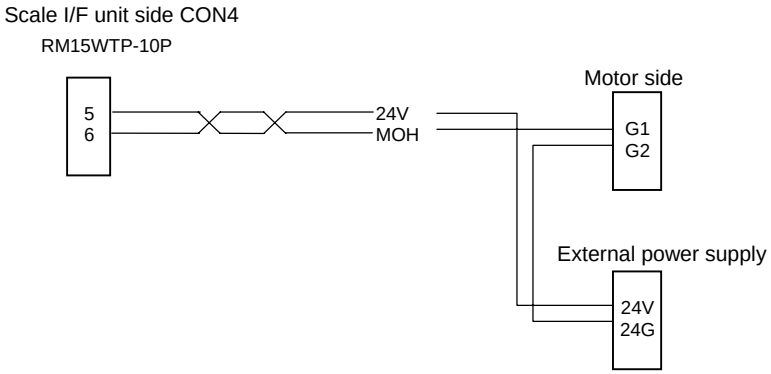
8-5-5 Cable for scale I/F unit – pole detector

<CNLH4MD cable connection diagram>

This is an actual connection diagram for the CNLH4MD cable supplied by Mitsubishi.



8-5-6 Cable for I/F unit – motor thermal

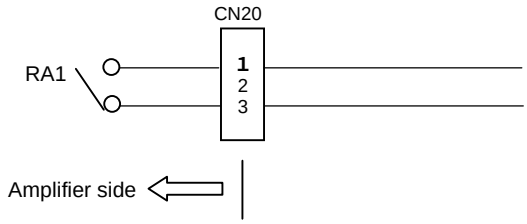


⚠ CAUTION

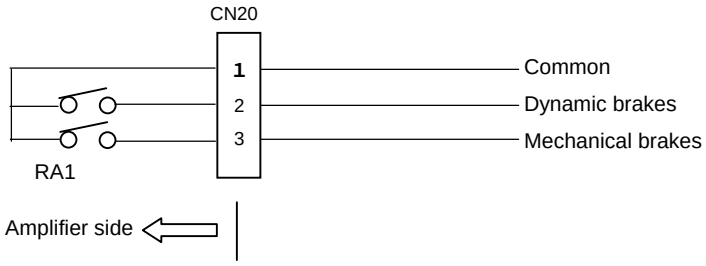
1. Do not connect anything to pins unless particularly described when manufacturing cable. (Leave OPEN.)
2. Contact Mitsubishi before manufacturing cable over 30m long.

8-5-7 Mechanical brake cable

(1) 9kW or less mechanical brakes



(2) 11, 15kW mechanical brakes and dynamic brakes

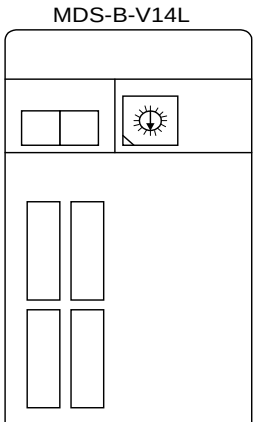


Chapter 9 Setup

9-1 Initial setup of servo drive unit

9-1-1 Setting the rotary switches

Before turning ON the power, the axis No. must be set with the rotary switches. The rotary switch settings will be validated when the servo driver (servo drive unit) power is turned ON.



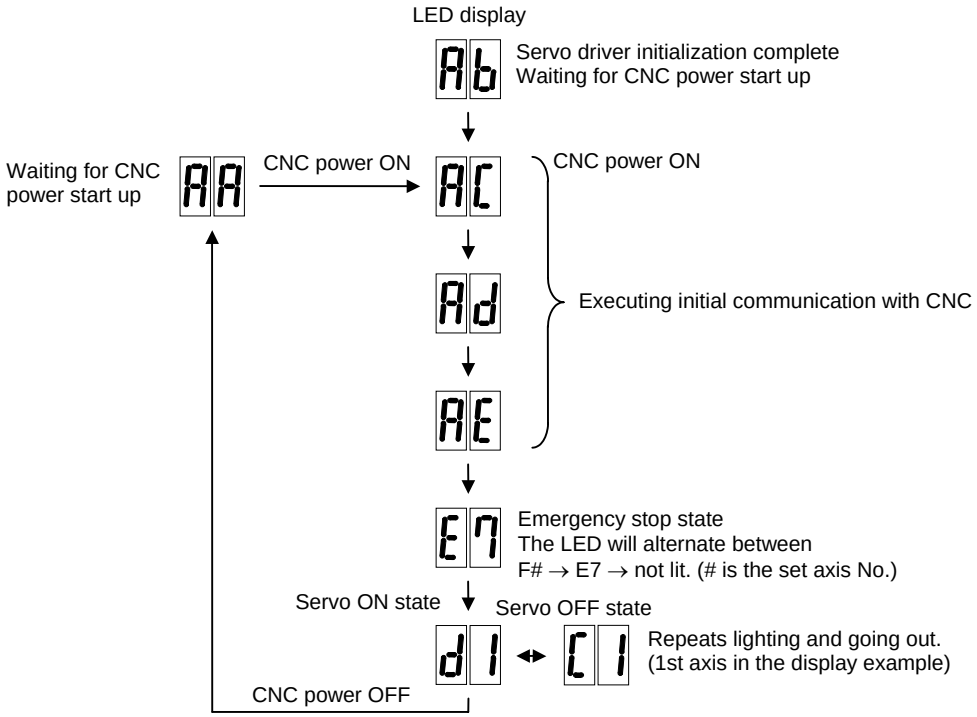
Rotary switch setting	Set axis No.
0	1st axis
1	2nd axis
2	3rd axis
3	4th axis
4	5th axis
5	6th axis
6	7th axis
7	Not usable
8	
9	
A	
B	
C	
D	
E	
F	Axis not used

POINT

When an axis that is not used is selected, that axis will not be controlled when the power is turned ON, and "Ab" will remain displayed on the LED.
If the power of the axis not in use is disconnected, the system's emergency stop cannot be released.

9-1-2 Transition of LED display after power is turned ON

When the axis No. has been set and the servo driver power and CNC power have been turned ON, the servo driver will automatically execute self-diagnosis and initial settings for operation, etc. The LEDs on the front of the servo driver will change as shown below according to the progression of these processes.
If an alarm occurs, the alarm No. will appear on the LEDs. Refer to "Chapter 11 Troubleshooting" for details on the alarm displays.



9-2 Setting the initial parameters

9-2-1 Setting the initial parameters

(1) Command polarity/feedback polarity (SV017: SPEC)

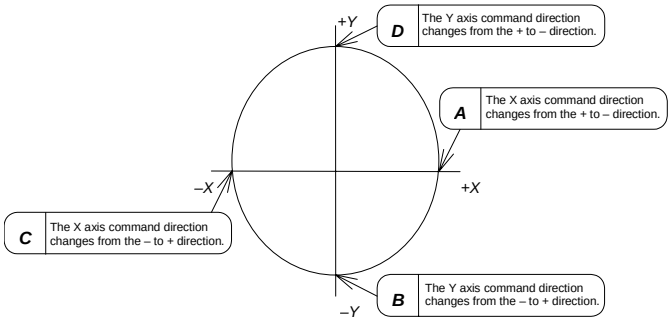
Command polarity

When the motor is to rotate in the clockwise direction (looking from the load side) when the command is used in the + direction, the command direction is CW. Conversely, when the motor is to rotate in the counterclockwise direction, the command direction is CCW.
This rotation direction can be set with the CNC machine parameters. Note that the meaning of the ± will differ for some servo parameters according to this motor rotation direction. The servo parameters affected by CW/CCW are shown below.

SV016:LMC1 SV041:LMC2 (When different values are set for SV016 and SV041)
SV031:OVS1 SV042:OVS2 (When different values are set for SV031 and SV042)

<Example> If the lost motion compensation amount is to be changed according to the direction, the compensation amount at the quadrant change-over point of each axis where the lost motion compensation is applied will be as shown below according to the command polarity.

	CW	CCW
A	X:SV041	X:SV016
B	Y:SV016	Y:SV041
C	X:SV016	X:SV041
D	Y:SV041	Y:SV016



Feedback polarity

Name	Abbrev.	Details	Setting range (unit)
SV017	SPEC	**Servo specifications**	HEX setting

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
spm				drvall	drvup	mpt3	mp	abs	vmh	vdir	fdir		seqh	dfbx	vdir2

bit	Name	Meaning when "0" is set	Meaning when "1" is set
0	vdir2	Sub side (CN3 connector) feedback forward polarity	Sub side (CN3 connector) feedback reverse polarity
4	fdir	Main side (CN2 connector) feedback forward polarity	Main side (CN2 connector) feedback reverse polarity

- fdir must be set according to the motor power line and linear scale installation state. Refer to 9-3 Initial setup of the linear servo system.
- vdir2 must be set only for the 2-scale 2-motor system (system using feedback on sub side.)
  Refer to 9-3-4 Setting the parallel drive system.

(2) Servo specifications (SV017: SPEC)

The following parameters are set according to the system specifications such as the servomotor type, motor and driver (servo drive unit) combination, and absolute position system or incremental position system, etc.

Name	Abbrev.	Details	Setting range (unit)
SV017	SPEC	**Servo specifications**	HEX setting

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
spm				drvall	drvup	mpt3	mp	abs	vmh	vdir	fdir		seqh	dfbx	vdir2

bit	Name	Meaning when "0" is set	Meaning when "1" is set
0	vdir2	Sub side (CN3 connector) feedback forward polarity	Sub side (CN3 connector) feedback reverse polarity
1	dfbx	Set to "0".	
2	seqh	READY/servo ON time, normal mode	READY/servo ON time, time reduction mode
3		Set to "0".	
4	fdir	Main side (CN2 connector) feedback forward polarity	Main side (CN2 connector) feedback reverse polarity
5	vdir	Set to "0".	
6	vmh	Normal processing mode	High-speed processing mode ∗ For the linear system, set the high-speed processing mode.
7	abs	Incremental position detection	Absolute position detection
8	mp	Set to "0".	
9	mpt3	Set to "0".	
A	drvup	Combination with standard motor driver	Set when using a combination with a driver having a capacity one rank above or below the standard motor drive.
B	drvall	Normal setting	Set when using a combination of driver having a capacity different from the standard motor driver.
C	spm	Standard linear motor: 6 Special linear motor : 7 Refer to (5) List of motor types.	
D			
E			
F			

(3) Ball screw pitch (SV018: PIT)

SV018	PIT	Set the magnetic pole pitch. The pole pitch is determined by the motor type. Refer to 9-2-4 List of standard parameters for each motor.	1 to 32767 (mm)

(4) Detector resolution (SV019: RNG1, SV020: RNG2)

Set the following parameters according the detector resolution.

SV019	RNG1	Set the resolution per magnetic pole pitch of the detector used for position control.	1 to 9999 (Kp/PIT)
SV020	RNG2	Set the resolution per pole pitch of the detector used for speed control.	1 to 9999 (Kp/PIT)

Linear motor system

Motor end detector	AT342		LC191M		HR+increment al scale∗3		HR+AT342 ∗3	
	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2
	120	120	600	600	∗2	∗2	1500	1500

∗2 Set the resolution per magnetic pole pitch in RNG1 and 2.
∗3 HR means the MDS-B-HR unit, and is indicated when this unit is connected between the scale.

(Caution) The above settings are for a linear motor having a magnetic pole pitch of 60mm.

(5) Motor type (SV025: MTYP)

Set the combination with SV017: SPEC spm in SV025: MTYP mtyp.

Name	Abbrev.	Details	Setting range (unit)
SV017	SPEC	**Servo specifications** F E D C B A 9 8 7 6 5 4 3 2 1 0 spm | drvall | drvup | mpt3 | mp | abs | vmh | vdir | fdir | | seqh | dfbx | vdir2 bit C D E F: Name: spm; Meaning when "0" is set: Standard linear motor: 6, Special linear motor : 7; Meaning when "1" is set:	HEX setting

Name	Abbrev.	Details	Setting range (unit)
SV025	MTYP	**Motor/detector type** F E D C B A 9 8 7 6 5 4 3 2 1 0 Pen | ent | mtyp	HEX setting

1) Standard linear motor

SV017: SPEC = 6xxx

Set the Nos. given in the following table in SV025: mtyp (bit 0 to bit 7) according to the linear motor (LM-□) being used.

For self-cooling, "NP□□□□M" (excluding the hyphen) is displayed on the CNC screen. For oil-cooling, the following type "NP□□□□Mc" (excluding the hyphen) with a "c" added to the end is displayed.

Cooling method	Self-cooling	Oil-cooling														
Motor series	Standard	Standard														
No.	0x	1x	2x	3x	4x	5x	6x	7x	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0	NP2S·05M	NP2S·05M														
x1	NP2M·15M	NP2M·15M														
x2	NP2L·15M	NP2L·15M														
x3																
x4	NP4S·10M	NP4S·10M														
x5	NP4M·20M	NP4M·20M														
x6	NP4L·30M	NP4L·30M														
x7	NP4G·40M	NP4G·40M														
x8		NP6A·25F														
x9																
xA																
xB																
xC																
xD																
xE																
xF																

2) Special linear motor

SV017: SPEC = 7xxx
SV025: Set the following Nos. in SV025: mtyp (bit 0 to bit 7).

Cooling method								
Motor series								
No.	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0								
x1								
x2								
x3								
x4								
x5								
x6								
x7								
x8								
x9								
xA								
xB								
xC								
xD								
xE								
xF								

(6) Detector type (SV025: MTYP)

Set the following parameter according to the detector being used.

Name	Abbrev.	Details	Setting range (unit)
SV025	MTYP	**Motor/detector type** F E D C B A 9 8 7 6 5 4 3 2 1 0 Pen ent mtyp pen : Set the position detector type ent : Set the speed detector type.	HEX setting

Set SV025: MTYP pen/ent according to the following table.

No.	Detection method	Detector type				Class	Remarks
A	High-speed serial	ABS SCALE *Note 2	MDS-B-HR			MAIN side detector	Set A for the linear motor.
B							
C						SUB side detector	Set D for pen when using the 2-scale 2-motor system (system using SUB side feedback).
D	High-speed serial	ABS SCALE *Note 2	MDS-B-HR				
E							
F							

Note 2: ABS SCALE (absolute scale) corresponds to the following absolute position detection scales.
Mitsutoyo AT342
Heidenhain LC191M

Detection system and MTYP

Refer to the following table and set SV025: MTYP according to the detection system.

Linear motor system

MAIN side detector	AT342 LC191M		HR+ AT342 (special)		HR+MD		HR+MD+ AT342 (special)		* ABS (Absolute system)
	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	
	AAxx	ABS possible	AAxx	ABS possible	AAxx	INC	AAxx	ABS possible	

2-scale 2-motor (2-amplifier) linear motor system
(Set to the slave axis when using a system that uses the sub side (CN3 connector) feedback.)

SUB side detector	AT342 LC191M		HR+ AT342 (special)		HR+MD		HR+MD+ AT342 (special)		* ABS (Absolute system)
	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	
	DAxx	ABS possible	DAxx	ABS possible	DAxx	INC	DAxx	ABS possible	

(7) Power supply type (SV036: PTYP)

Name	Abbrev.	Details	Setting range (unit)
SV036	PTYP	**Power supply type** F E D C B A 9 8 7 6 5 4 3 2 1 0 amp | rtyp | ptyp	HEX setting

bit	Name	Details
0	ptyp	Set the power supply type.
1		
2		
3		
4		
5		
6		
7		
8	rtyp	Set 0 if the power supply unit is a power regeneration type. If the power supply unit is a resistance regeneration type, set the type of resistor being used.
9		
A		
B		
C	amp	Set the driver model No. 0: MDS-B-V14/V24, V14L, MDS-B-V1/V2/SP, MDS-A-V1/V2/SP 1: MDS-A-SVJ 2: MDS-A-SPJ
D		
E		
F		

Refer to the following table and set SV036: PTYP ptyp.

No.	0xKw 0x	1xKw 1x	2xKw 2x	3xKw 3x	4xKw 4x	5xKw 5x	6x	7x	0xKw 8x
0	PS not connected			CV-300					
1		CV-110							CR-10
2			CV-220						CR-15
3									CR-22
4	CV-37								CR-37
5		CV-150			CV-450	CV-550			
6	CV-55		CV-260						CR-55
7				CV-370					
8	CV-75								CR-75
9		CV-185							CR-90
A									
B									
C									
D									
E									
F									

List of regenerative resistor types

Refer to the following table and set SV036: PTYP port. (For MDS-A-CR unit)

No.	Regenerative resistor type	Resistance value (Ω)	Wattage (W)
0			
1	GZG200W260HMJ	26	80
2	GZG300W130HMJ×2	26	150
3	MR-RB30	13	300
4	MR-RB50	13	500
5	GZG200W200HMJ×3	6.7	350
6	GZG300W200HMJ×3	6.7	500
7	R-UNIT-1	30	700
8	R-UNIT-2	15	700
9	R-UNIT-3	15	2100
A			
B			
C			
D			
E			
F			

9-2-2 Parameters set according to feedrate

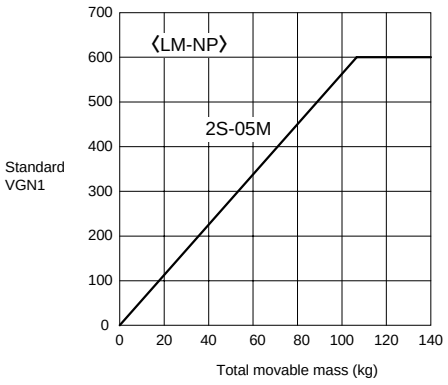
The following parameters are determined according to each axis' feedrate.

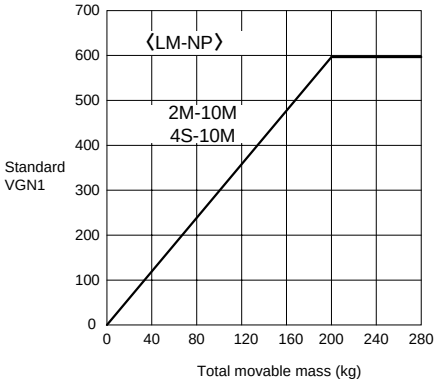
No.	Abbrev.	Parameter name	Explanation
SV023	OD1	Excessive error detection width at servo ON	A protective function will activate if the error between the position command and position feedback is excessive. If the machine load is heavy and problems occur with the standard settings, gradually increase the setting value. **<Calculation of standard setting value>** $OD1 = OD2 = \frac{\text{Max. rapid traverse rate (mm/min)}}{60 \times PGN1} \times 0.5\ (mm)$
SV026	OD2	Excessive error detection width at servo OFF	

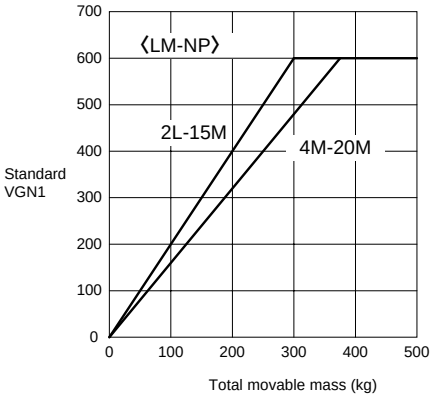
9-2-3 Parameters set according to machine movable mass

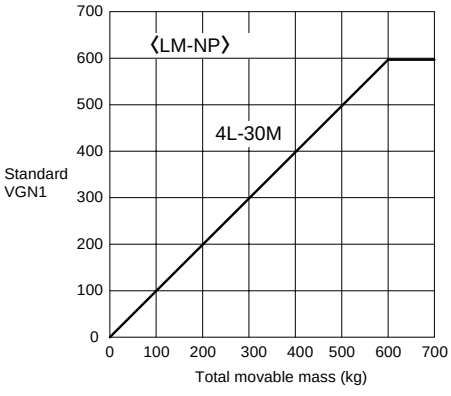
The following parameters are set according to the machine's movable mass (including motor mass).

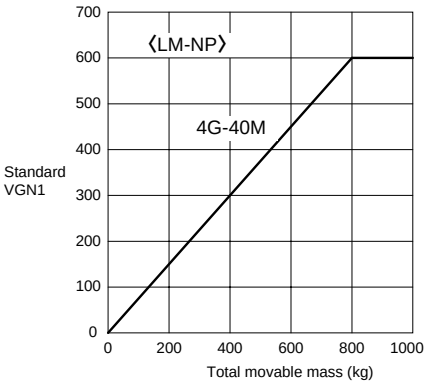
No.	Abbrev.	Parameter name	Explanation
SV005	VGN1	Speed loop gain.	Refer to the comparison graph with the total movable mass (including motor mass) for the standard setting value.
SV008	VIA	Speed loop leading compensation	Set 1364 as a standard. Set 1900 as a standard for the SHG control. If the total movable mass is large and the VGN1 value is smaller than the standard value, a lower value can be set regardless of whether normal control or SGH control is used.











9-2-4 List of standard parameters for each motor

List of standard parameters for each motor

Motor	Linear servomotor (self-cooling)									Linear servomotor (oil-cooling)								
	LM-NP 2S-05 M	LM-NP 2M-10 M	LM-NP 2L-15 M	LM-NP 4S-10 M	LM-NP 4M-20 M	LM-NP 4L-30 M	LM-NP 4G-40 M			LM-NP 2S-05 M	LM-NP 2M-10 M	LM-NP 2L-15 M	LM-NP 4S-10 M	LM-NP 4M-20 M	LM-NP 4L-30 M	LM-NP 4G-40 M	LM-NP 6A-25F		
Driver	20	35	45	35	45	90	110			20	35	45	35	45	90	110	45		
SV001	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1		
SV002	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1		
SV003	47	47	47	47	47	47	47			47	47	47	47	47	47	47	47		
SV004	125	125	125	125	125	125	125			125	125	125	125	125	125	125	125		
SV005	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-		
SV006	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV007	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV008	1364	1364	1364	1364	1364	1364	1364			1364	1364	1364	1364	1364	1364	1364	1364		
SV009	10240	10240	10240	10240	10240	10240	10240			10240	10240	10240	10240	10240	10240	10240	10240		
SV010	10240	10240	10240	10240	10240	10240	10240			10240	10240	10240	10240	10240	10240	10240	10240		
SV011	1024	1024	1024	1024	1024	1024	1024			1024	1024	1024	1024	1024	1024	1024	1500		
SV012	1024	1024	1024	1024	1024	1024	1024			1024	1024	1024	1024	1024	1024	1024	1500		
SV013	500	500	500	500	500	500	500			500	500	500	500	500	500	500	500		
SV014	500	500	500	500	500	500	500			500	500	500	500	500	500	500	500		
SV015	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV016	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV017	6xxx	6xxx	6xxx	6xxx	6xxx	6xxx	6xxx			6xxx	6xxx	6xxx	6xxx	6xxx	6xxx	6xxx	6xxx		
SV018	60	60	60	60	60	60	60			60	60	60	60	60	60	60	60		
SV019	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-		
SV020	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-		
SV021	60	60	60	60	60	60	60			60	60	60	60	60	60	60	60		
SV022	150	150	150	150	150	150	150			150	150	150	150	150	150	150	150		
SV023	20	20	20	20	20	20	20			20	20	20	20	20	20	20	20		
SV024	50	50	50	50	50	50	50			50	50	50	50	50	50	50	50		
SV025	xx00	xx01	xx02	xx04	xx05	xx06	xx07			xx10	xx11	xx12	xx14	xx15	xx16x	xx17	xx18		
SV026	20	20	20	20	20	20	20			20	20	20	20	20	20	20	20		
SV027	4000	4000	4000	4000	4000	4000	4000			4000	4000	4000	4000	4000	4000	4000	4000		
SV028	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-		
SV029	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV030	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV031	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV032	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV033	0000	0000	0000	0000	0000	0000	0000			0000	0000	0000	0000	0000	0000	0000	0000		
SV034	0003	0003	0003	0003	0003	0003	0003			0003	0003	0003	0003	0003	0003	0003	0003		
SV035	0000	0000	0000	0000	0000	0000	0000			0000	0000	0000	0000	0000	0000	0000	0000		
SV036	0000	0000	0000	0000	0000	0000	0000			0000	0000	0000	0000	0000	0000	0000	0000		
SV037	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV038	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV039	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV040	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV041	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV042	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV043	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV044	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV045	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV046	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV047	100	100	100	100	100	100	100			100	100	100	100	100	100	100	100		
SV048	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV049	15	15	15	15	15	15	15			15	15	15	15	15	15	15	15		
SV050	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV051	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV052	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV053	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV054	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV055	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV056	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV057	281	281	281	281	281	281	281			281	281	281	281	281	281	281	281		
SV058	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV059	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV060	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV061	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV062	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV063	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
SV064	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0		
OS1																			
OS2																			

9-3 Initial setup of the linear servo system

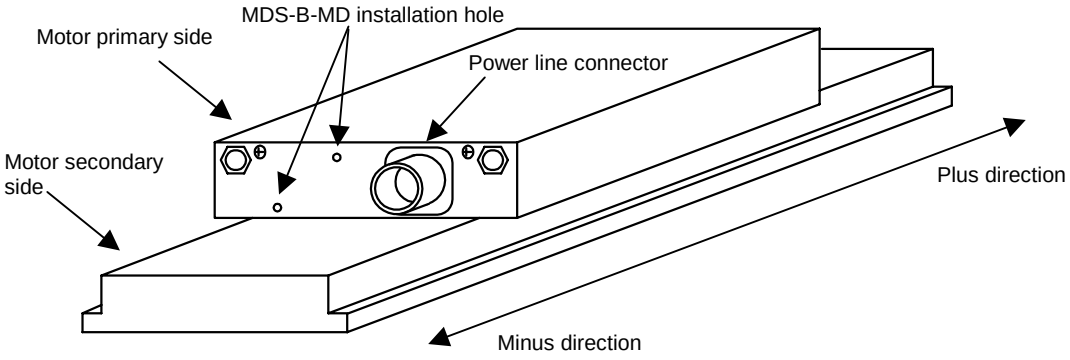
The motor is driven by the magnetic force created by the coil and the magnetic force of the permanent magnet. Thus, it is necessary to comprehend at which pole of the permanent magnet the coil is located. With the conventional rotary motor, the coil and permanent magnet are located in the motor, and the relation of the two parts is fixed. The relation of the detector installed on the motor and the motor itself is also fixed.
With the linear servo system the coil (motor primary side), permanent magnet (motor secondary side) and linear scale are independently installed, so the pole must be adjusted according to the linear motor and linear scale relation.
If this pole is not adjusted, the motor may not operate or may not operate correctly.
The magnetic pole adjustment method is explained in this section.

9-3-1 Installation of linear motor and linear scale

The installation direction of the linear motor and linear scale is explained in this section.

(1) Linear motor's magnetic pole direction

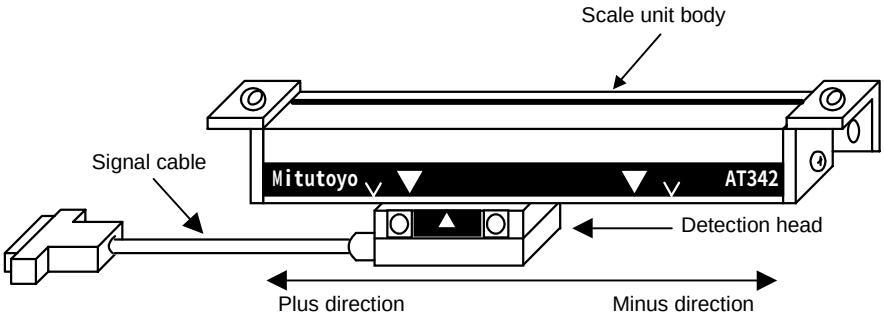
The magnetic pole direction of the linear motor is shown below. As shown in the drawing, if moved in the direction having the power line connector or MDS-B-MD installation hole, the pole will move in the minus direction. If moved in the opposite direction, the pole will move in the plus direction.



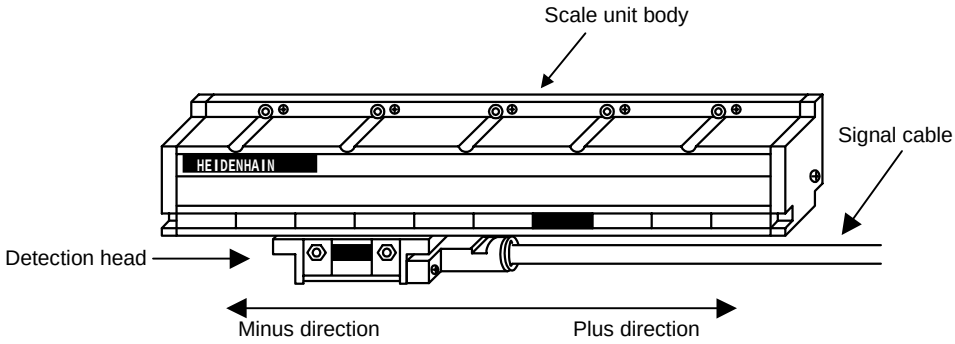
(2) Feedback direction of linear scale

The linear scales include the AT342 scale and Heidenhain scale, etc. The feedback direction of the AT342 scale is shown below. When moved to the left, looking from the direction with the detector head facing downward and the AT342 display facing forward, the feedback moves in the plus direction. When moved in the opposite direction, the position moves in the minus direction. The plus/minus directions of the Heidenhain scale are the opposite of the AT342 scale.

AT342 scale unit



Heidenhain scale unit



If the linear motor's pole direction and linear scale's feedback direction are same, the state is called forward polarity. If these directions differ, the state is called reverse polarity. Normally, these are installed to achieve forward polarity, but can be installed to achieve reverse polarity. The polarity achieved with the linear motor and linear scale installation directions is shown below. Refer to this table, and set the pole direction and feedback direction relation in the following parameter. When this parameter is set, the servo driver's position direction can be reversed. Thus, the position data displayed on the CNC Servo Monitor screen will have a plus/minus direction opposite from the linear scale feedback direction.
(The Heidenhain scale indicates the case of the A, B phase analog output of the measurement length system LS, LIDA and LIF. Thus, when using another scale, confirm that the A and B phase analog outputs have the same relation.

No.	Abbrev.	Parameter name	Details
SV017	SPEC	Servo specifica-tion s	This is a HEX setting parameter. Set this as follows according to the servo specification.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
spm				drvall	drvup	mpt3	mp	abs	vmh	vdir	fdir		seqh	dfbx	vdir2

Bit		Meaning when "0" is set	Meaning when "1" is set
4	fdir	Main side (CN2) feedback forward polarity	Main side (CN2) feedback reverse polarity

Table of feedback polarities according to linear motor and linear scale installation directions

Connected scale		AT342 scale		Heidenhain scale	
Item		Polarity	SPEC (fdir)	Polarity	SPEC (fdir)
Fig. No.	Fig. 9.3.1 (1)	Forward polarity	0	Reverse polarity	1
	Fig. 9.3.1 (2)	Reverse polarity	1	Forward polarity	0
	Fig. 9.3.1 (3)	Reverse polarity	1	Forward polarity	0
	Fig. 9.3.1 (4)	Forward polarity	0	Reverse polarity	1
	Fig. 9.3.2 (1)	Reverse polarity	1	Forward polarity	0
	Fig. 9.3.2 (2)	Forward polarity	0	Reverse polarity	1
	Fig. 9.3.2 (3)	Forward polarity	0	Reverse polarity	1
	Fig. 9.3.2 (4)	Reverse polarity	1	Forward polarity	0

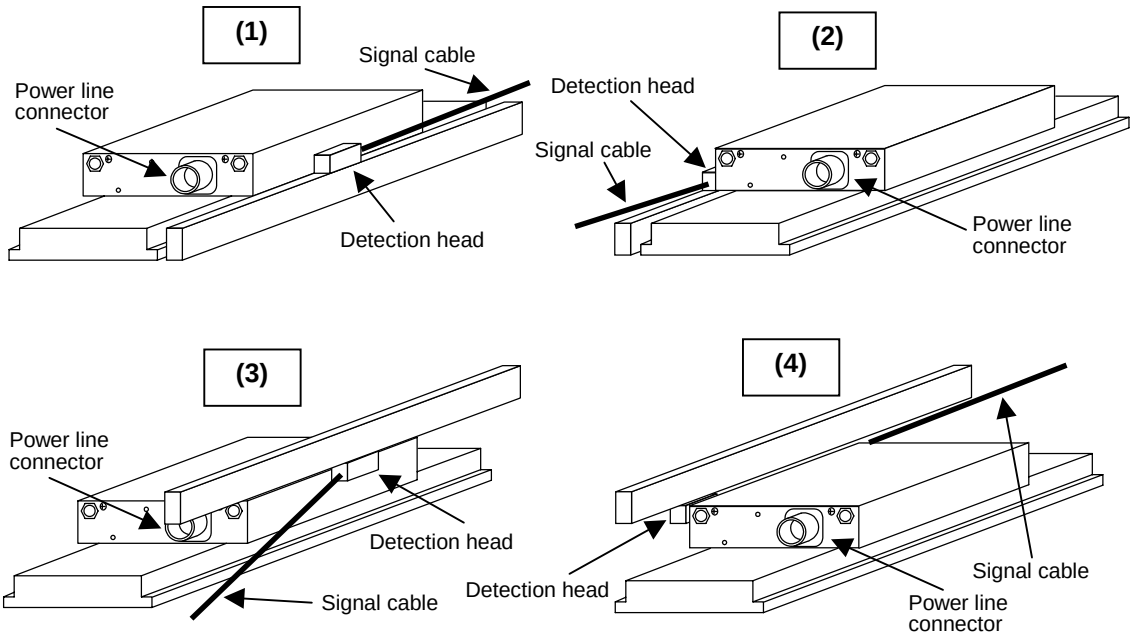


Fig. 9.3.1 When linear scale detection head is installed on motor's primary side (This is for the AT342. The signal cable direction is reversed for the Heidenhain scale.)

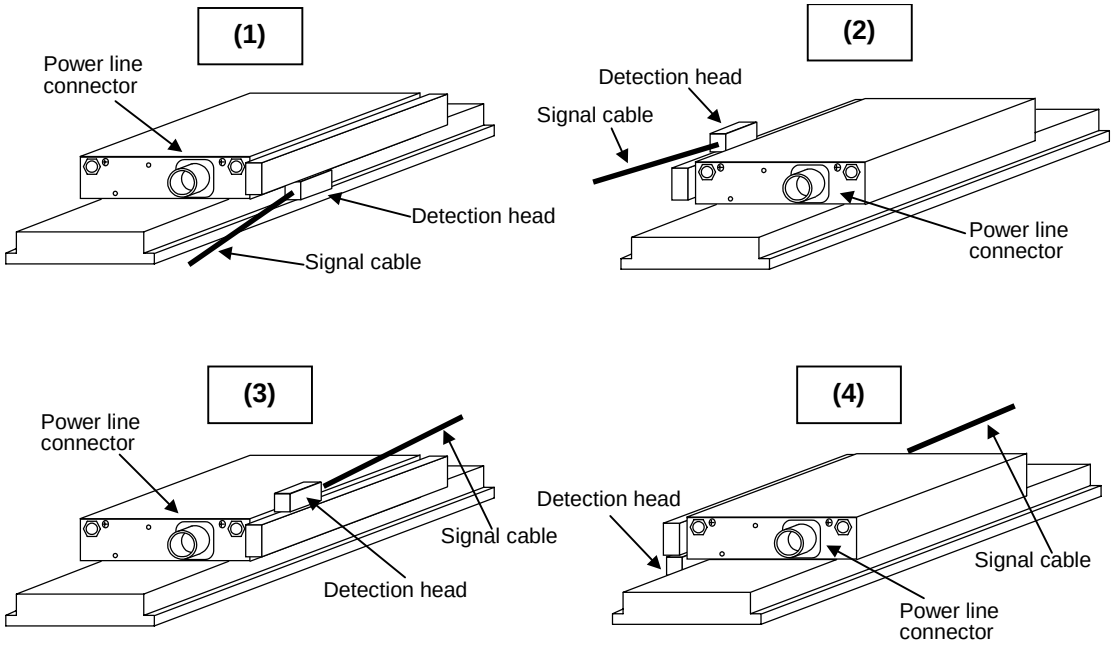


Fig. 9.3.2 When linear scale body is installed on motor's primary side
(This is for the AT342. The signal cable direction is reversed for the Heidenhain scale.)

9-3-2 DC excitation function

By using the DC excitation function, the linear motor can be moved to the 0° pole regardless of the feedback from the linear scale.
This DC excitation function is required to determine the magnetic pole shift amount. When determining the pole shift amount, carry out DC excitation after confirming that the cycle counter displayed on the CNC Servo Monitor screen is not 0 (Z phase passed).
The following parameters are used for DC excitation.

No.	Abbrev.	Parameter name	Explanation
SV034	SSF3	Special servo function selection 3	This is a HEX setting parameter. Set this as follows according to the servo specification.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ovsn				linN				toff	os2		dcd	test	mohn	has2	has1

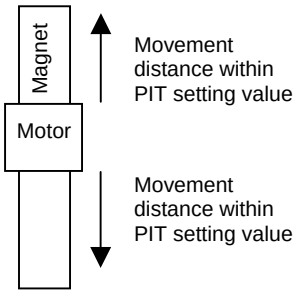
Bit		Meaning when "0" is set	Meaning when "1" is set
4	dcd	Setting for normal use	DC excitation mode

No.	Abbrev.	Parameter name	Explanation	Setting range
SV061	DA1NO	D/A output channel 1· data No.	Set the initial excitation level for DC excitation. Set a minus value. Set –250 when starting DC excitation.	–32768 to 32767
SV062	DA2NO	D/A output channel 2· data No.	Set the final pole level for DC excitation. Set a minus value. Set –250 when starting DC excitation.	–32768 to 32767
SV063	DA1MPY	D/A output channel 1· output scale	Set the initial excitation time for DC excitation. (ms) Normally, 500 is set.	–32768 to 32767

***** Set so that each setting value with |SV061| ≤ |SV062| is a minus value.

<Adjustment methods>

1. Secure the distance (PIT) that the linear motor could move during DC excitation as shown on the right.
2. Set SV034/dcd to "1", and the setting values for starting DC excitation in SV061 to SV063.
3. Release the emergency stop. (DC excitation start)
4. Apply the emergency stop. (DC excitation end)



<Operation>

1. When the emergency stop is released, the current set in SV061 will flow to the V phase (V phase excitation) for (SV063 setting value × 1/2) msec, and the motor will move toward the pole 120°. At this time, the direction and distance that the linear motor position will move when the emergency stop is released will differ as shown below.
   (It may not be possible to confirm movement when already near pole 120°.)
2. Next, the current set in SV061 will flow the U phase (U phase excitation) for (SV063 setting value x 1/2) msec, and the motor will move toward the pole 0°. In this case, the movement will be in the same direction for all examples shown below.
3. Finally, the current set in SV062 will flow to the U phase, and the pole 0° position will be established.

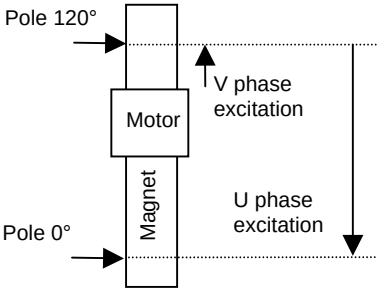


Fig. 9.3.3 When linear motor is between pole 0° and 120°

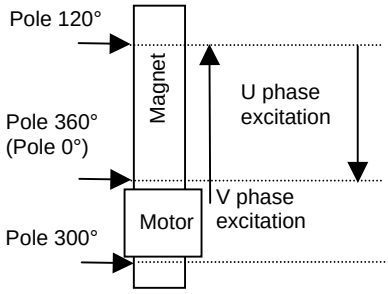


Fig. 9.3.4 When linear motor is between pole 300° and 360°

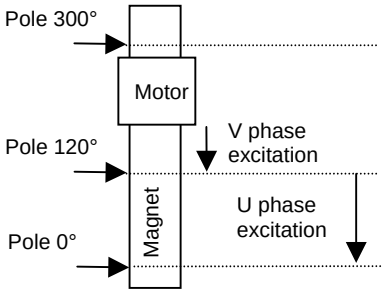


Fig. 9.3.5 When linear motor is between pole 120° and 300°

<Confirmation>

1. During DC excitation, confirm the value displayed at MAX CURRENT 2 value on the CNC Servo Monitor screen.
   If the linear motor does not move even when the MAX CURRENT 2 value is 100 or more, the cable connection may be incorrect, so confirm the connection.
2. Confirm the MAIN side feedback polarity (SPEC/fdir) achieved with DC excitation.
   The MAIN side feedback polarity can be confirmed with the direction that the linear motor moves during U phase excitation, and the increment/decrement of the cycle counter displayed on the CNC Servo Monitor screen. Judge whether the polarity confirmed with DC excitation matches the polarity set with the servo parameters. Correct the servo parameter polarity if incorrect.

fdir correction table according to linear motor movement with DC excitation.

Linear motor movement	Linear motor polarity Minus direction		Linear motor polarity Plus direction	
Cycle counter increment/decrement	Increment	Decrement	Increment	Decrement
ABS SCALL	Correctly set	Incorrectly set	Incorrectly set	Correctly set
MDS-B-HR	Incorrectly set	Correctly set	Correctly set	Incorrectly set

9-3-3 Setting the pole shift

When the linear motor and linear scale are installed, the linear motor does not know which pole the permanent magnet is at. Thus, if the linear motor is driven in that state, it may not move or could runaway. By setting the pole shift amount, the linear motor can be driven correctly no matter which pole it is at.
For the pole shift amount, set the data displayed at Rn on the CNC Absolute Position Monitor screen during DC excitation (while the emergency stop is released).

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV028	MSFT	Pole shift amount	Set the pole shift amount	–30000 to 30000 (μm)

* The SV028 setting value is validated after the CNC power is rebooted.

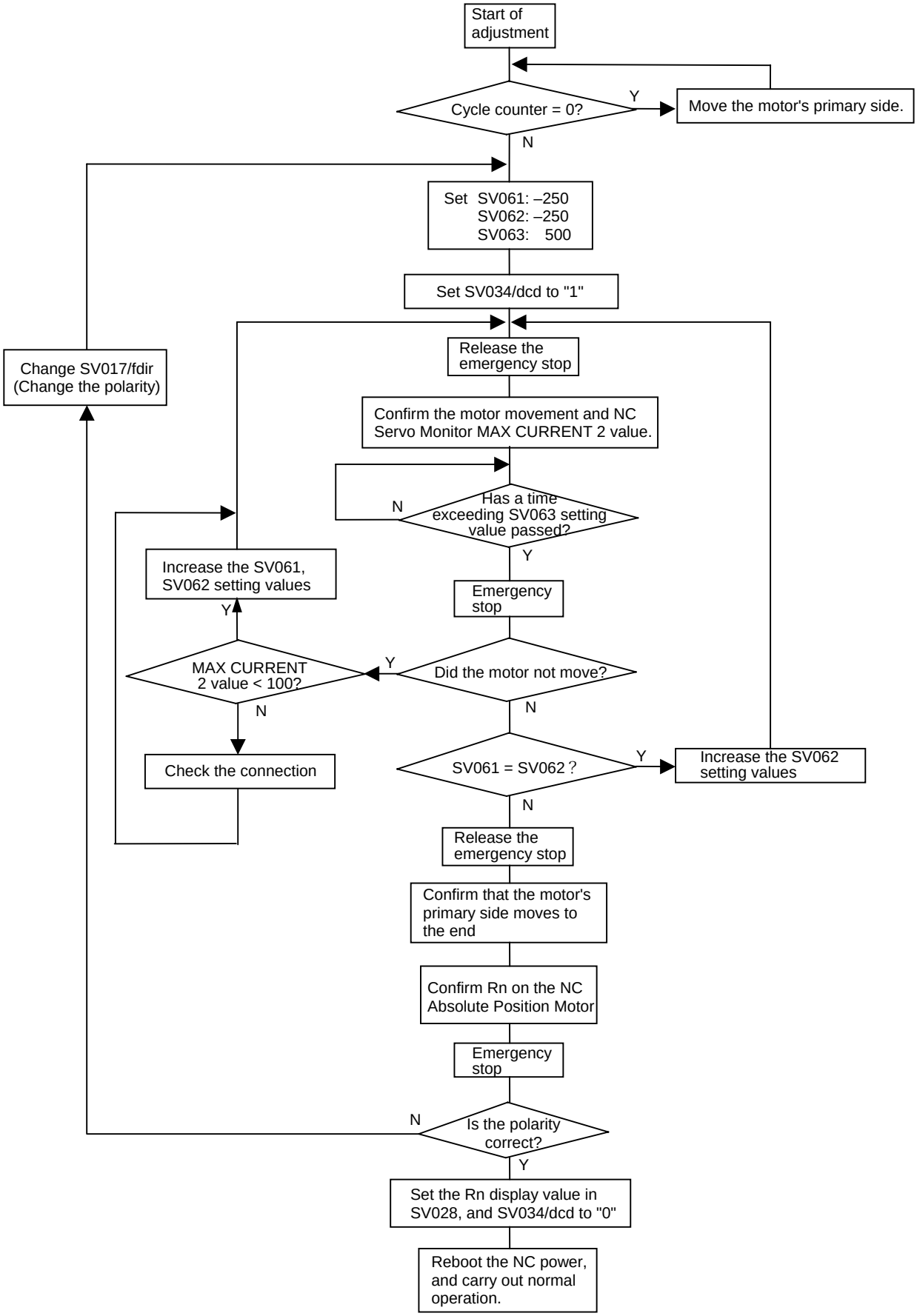
(1) For system to which MDS-B-MD is not connected

If the pole shift amount is set, it will be validated after the CNC power is rebooted.

(2) For system to which MDS-B-MD is connected

Normally, the motor is driven with the pole created by MDS-B-MD. However, if this pole shift amount is set, it will be validated when the Z phase has been passed once after the CNC power has been rebooted. However, if there is a deviation of 30° or more between the pole before and after pole shifting, the pole shift amount will not be validated, and instead the 9B warning (Pole shift warning) will be detected. The motor will be driven with the pole achieved before pole shifting.
If the 9B alarm occurs, carry out DC excitation again to determine the pole shift amount. The correct pole shift amount can be achieved even if a value is set in SV028 at this time.

Flow chart for DC excitation and pole shift amount setting



9-3-4 Setting the parallel drive system

When driving the linear motor with a parallel drive system, confirm that the following parameters are correctly set for the (1), (2) 2-scale 2-motor (2-amplifier) control or (3) 1-scale 2-motor (2-amplifier) control method. If incorrectly set, correct the setting and reboot the CNC power supply.
When using a parallel drive system, do not simultaneously DC excite the master side and slave side. When carrying out DC excitation of either axis, make sure that current is not flowing to the other axis.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Details</th></tr>
<tr><td>SV017</td><td>SPEC</td><td>Servo specifica-tion s</td><td>This is a HEX setting parameter. Set this as follows according to the servo specification.
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">spm</td><td>drvall</td><td>drvup</td><td>mpt3</td><td>mp</td><td>abs</td><td>vmh</td><td>vdir</td><td>fdir</td><td></td><td>seqh</td><td>dfbx</td><td>vdir2</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>4</td><td>fdir</td><td>Main side (CN2) feedback forward polarity</td><td>Main side (CN2) feedback reverse polarity</td></tr>
<tr><td>0</td><td>vdir2</td><td>Sub side (CN3) feedback forward polarity</td><td>Sub side (CN3) feedback reverse polarity</td></tr>
</table></td></tr>
<tr><td>SV025</td><td>MTYP</td><td>Motor/ detector type</td><td>This is a HEX setting parameter. Set this as follows according to the detector type.
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">pen</td><td colspan="4">ent</td><td colspan="8">mtyp</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Details</th></tr>
<tr><td>8</td><td rowspan="4">ent</td><td rowspan="4">Set the position detector type
(Refer to 9-2-1 (6) Detector type list)</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td><td rowspan="4">pen</td><td rowspan="4">Set the speed detector type.
(Refer to 9-2-1 (6) Detector type list)</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td></tr>
</table></td></tr>
</table>

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV028	MSFT	Pole shift amount	Set the pole shift amount	–30000 to 30000 (µm)

(1) 2-scale 2-motor (2-amplifier) control (System using only main side (CN2 connector side) feedback)

Setting parameter	Master axis	Slave axis
SV017/fdir	Normally, set the setting value for control.	Normally, set the setting value for control.
SV017/vdir2	Set 0.	Set 0.
SV025/pen·ent	Set AAxx.	Set AAxx.
SV028	Normally, set the setting value for control.	Normally, set the setting value for control.

(2) 2-scale 2-motor (2-amplifier) control (System also using sub side (CN3 connector side) feedback)

Setting parameter	Master axis	Slave axis
SV017/fdir	Normally, set the setting value for control.	Normally, set the setting value for control.
SV017/vdir2	Set 0.	If the master axis and linear motor pole directions are the same, set to the same setting as SV017/fdir for the master axis. If the pole directions are reversed, set the opposite setting as SV017/fdir for the master axis.
SV025/pen·ent	Set AAxx.	Set DAxx.
SV028	Normally, set the setting value for control.	Normally, set the setting value for control.

(3) 1-scale 2-motor (2-amplifier) control

Setting parameter	Master axis	Slave axis
SV017/fdir	Normally, set the setting value for control.	If the master axis and linear motor pole directions are the same, set to the same setting as SV017/fdir for the master axis. If the pole directions are reversed, set the opposite setting as SV017/fdir for the master axis.
SV017/vdir2	Set 0.	Set 0.
SV025/pen·ent	Set AAxx.	Set AAxx.
SV028	Normally, set the setting value for control.	Set the pole shift amount when DC excitation is carried out with the connected detector.

⚠ CAUTION

When carrying out DC excitation with the parallel drive system, if the current flows to the parallel axis, the machine could break down or the accuracy may not be satisfied. When carrying out DC excitation with the parallel drive system, make sure that current does not flow to the parallel axis.

9-3-5 Settings when motor thermal is not connected

POINT

When driving the motor with a system connected to the MDS-B-HR, the servo driver's protection function will activate if the motor reaches an abnormal temperature. However, if the wire for the motor's abnormal temperature monitoring is not connected, the MDS-B-HR will attempt to activate this protection function. Thus, when driving a motor with a system that does not have this connection, set the following parameter to ignore the signal from the MDS-B-HR.

No.	Abbrev.	Parameter name	Explanation
SV034	SSF3	Special servo function selection 3	Set the motor thermal with the following parameter.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ovsn								toff	os2		dcd	test	mohm	has2	has2

bit		Meaning when "0" is set	Meaning when "1" is set
2	mohm	HR motor thermal valid	HR motor thermal invalid

Chapter 10 Adjustment

10-1 Measurement of adjustment data

The MDS-B-V14L servo driver has a function to D/A output the various control data. To adjust the servo and set the servo parameters that match the machine, it is necessary to use the D/A output and measure the internal status of the servo. Measure using a hi-coder, synchroscope, etc.

10-1-1 D/A output specifications

Item	Explanation
No. of channels	2 ch.
Output cycle	222μs (min. value)
Output precision	8-bit
Output voltage range	0 to +5V
Output scale setting	±1/258 to ±128 times
Output pins	CN9 connector Channel 1 = pin 9 Channel 2 = pin 19 GND = pin 1, 11

10-1-2 Setting the output data

No.	Abbrev.	Parameter name	Explanation
SV061	DA1NO	D/A output channel 1 data No.	Input the No. of the data to be output to each D/A output channel.
SV062	DA2NO	D/A output channel 2 data No.	

No.	CH1 output data	Standard output unit
-1	D/A output non-selection	
0	Speed feedback	m/sec
1	Current command	Rated (stall) current %
2	Current command	Rated (stall) current %
3	Current feedback	Rated (stall) current %
4	Speed feedback low-order	m/sec
5	Speed feedback high-order	m/sec
6	Position droop low-order	Interpolation unit
7	Position droop high-order	Interpolation unit
8	Position FΔT low-order	Interpolation unit/ NC communication cycle
9	Position FΔT high-order	Interpolation unit/ NC communication cycle
10	Position command low-order	Interpolation unit
11	Position command high-order	Interpolation unit
12	Feedback position low-order	Interpolation unit
13	Feedback position high-order	Interpolation unit
125	Test output saw-tooth wave	0 to +5V
126	Test output rectangular wave	0 to +5V
127	Test output 0V	

No.	CH2 output data	Standard output unit
-1	D/A output non-selection	
0	Current command	Rated (stall) current %
1	Current command	Rated (stall) current %
2	Current command	Rated (stall) current %
3	Current feedback	Rated (stall) current %
4	Speed feedback low-order	m/sec
5	Speed feedback high-order	m/sec
6	Position droop low-order	Interpolation unit
7	Position droop high-order	Interpolation unit
8	Position FΔT low-order	Interpolation unit/ NC communication cycle
9	Position FΔT high-order	Interpolation unit/ NC communication cycle
10	Position command low-order	Interpolation unit
11	Position command high-order	Interpolation unit
12	Feedback position low-order	Interpolation unit
13	Feedback position high-order	Interpolation unit
125	Test output saw-tooth wave	0 to +5V
126	Test output rectangular wave	0 to +5V
127	Test output 0V	

***** Interpolation unit
This is an CNC internal unit. The command unit (input unit) will be as shown on the right.

Command unit	Interpolation unit
10μm	5μm
1μm	0.5μm
0.1μm	0.05μm

10-1-3 Setting the output scale

No.	Abbrev.	Parameter name	Explanation	Setting range
SV063	DA1MPY	D/A output channel 1 output scale	The scale is set with a 1/256 unit. When 256 is set, the scale will be 1-fold.	–32768 to 32767
SV064	DA2MPY	D/A output channel 2 output scale		

Analog output voltage = {(output data value) × (SV063 or SV064 setting unit) × 76.3/1,000,000} + 2.5V

10-2 Gain adjustment

10-2-1 Current loop gain

No.	Abbrev.	Parameter name	Explanation	Setting range
SV009	IQA	Current loop q axis leading compensation	This setting is determined by the motor's electrical characteristics. Basically set the standard parameters for all parameters. (These are used for maker adjustments.)	1 to 20480
SV010	IDA	Current loop d axis leading compensation		1 to 20480
SV011	IQG	Current loop q axis gain		1 to 4096
SV012	IDG	Current loop d axis gain		1 to 4096

10-2-2 Speed loop gain

(1) Setting the speed loop gain

The speed loop gain (SV005: VGN1) is an important parameter for determining the responsiveness of the servo control. During servo adjustment, the highest extent that this value can be set to becomes important. The setting value has a large influence on the machine cutting precision and cycle time.

① To adjust the VGN1 value, first obtain the standard VGN1 to judge how much VGN1 is required for the machine total movable mass. The standard VGN1 differs according to the size of the machine's movable mass. Refer to the section "9-2-3 Parameters set according to machine movable mass".

<When machine resonance does not occur at the standard VGN1>

Set the standard VGN1. Use the standard value if no problem (such as machine resonance) occurs. If sufficient cutting precision cannot be obtained at the standard VGN1, VGN1 can be raised above the standard value if a 70 percent margin is maintained in respect to the machine resonance's occurrence limit. The cutting accuracy can also be improved by adjusting with the disturbance observer.

<When machine resonance occurs at the standard VGN1>

Machine resonance is occurring if the shaft makes abnormal sounds when operating or stopping, and a fine vibration can be felt when the machine is touched while stopped. Machine resonance occurs because the servo control responsiveness includes the machine resonance points. Machine resonance can be suppressed by lowering VGN1 and the servo control responsiveness, but the cutting precision and cycle time are sacrificed. Thus, set a vibration suppression filter and suppress the machine resonance (Refer to section "10-3-2 Vibration suppression measures"), and set a value as close as possible to the standard VGN1. If the machine resonance cannot be sufficiently eliminated even by using a vibration suppression filter, then lower the VGN1.

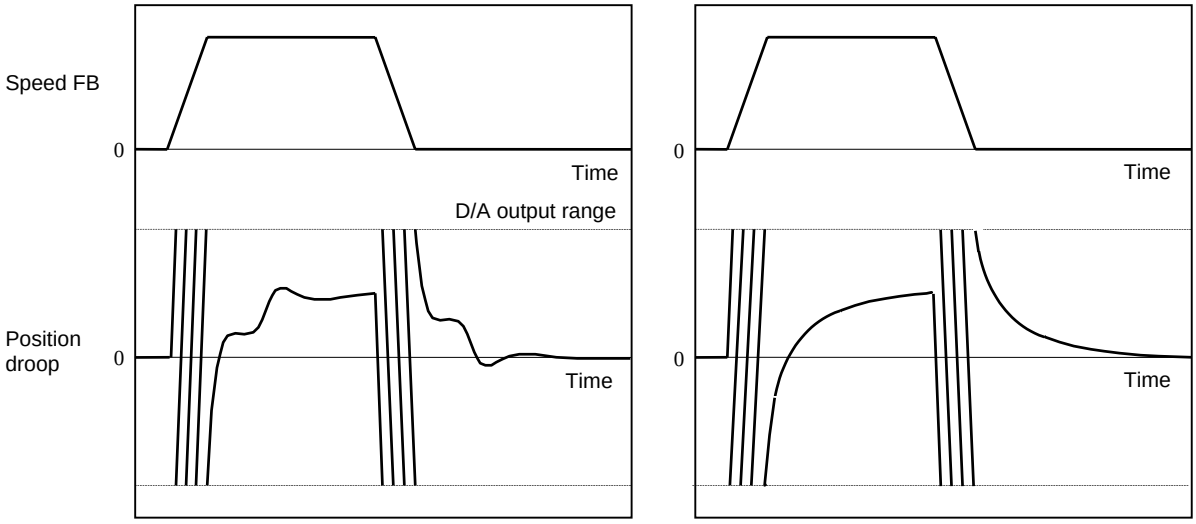
No.	Abbrev.	Parameter name	Explanation	Setting range
SV005	VGN1	Speed loop gain	Set this according to the movable mass size. If resonance occurs, adjust by lower the setting by 20% to 30% at a time.	1 to 999

POINT

The final VGN1 setting value should be 70 to 80% of the largest value at which machine resonance does not occur.
If the vibration suppression functions are used to suppress the resonance and the VGN1 setting value is raised, the subsequent servo adjustment becomes more favorable.

(2) Setting the speed loop leading compensation

The speed loop leading compensation (SV008: VIA) determines the characteristics of the speed loop mainly at low frequency regions. 1364 is set as a standard, and 1900 is set as a standard during SHG control. The standard value may drop for a machine having a large movable mass.
When the VGN1 is set lower than the standard value because the movable mass is large or because machine resonance occurred, the speed loop control band is lowered. If the standard value is set in the leading compensation in this status, the leading compensation control itself will induce vibration. In concrete terms, a vibration of 10 to 20Hz could be caused during acceleration/deceleration and stopping, and the position droop waveform could be disturbed when accelerating to a constant speed and when stopped. (Refer to the following left graphs.)
This vibration cannot be suppressed by the vibration suppression functions. Lower the VIA in decrement of 100 from the standard setting value. Set a value where vibration does not occur and the position droop waveform converges smoothly. Because lowering the VIA causes a drop in the position control's trackability, the vibration suppression is improved even when a disturbance observer is used without lowering the VIA. (Be careful of machine resonance occurrence at this time.)



Vibration waveform with leading compensation control **Adjusted position droop waveform**

If VIA is lowered, the position droop waveform becomes smooth and overshooting does not occur. However, because the trackability regarding the position commands becomes worse, that the positioning time and precision are sacrificed. VIA must be kept high (set the standard value) to guarantee precision, especially in high-speed contour cutting (generally F = 1000 or higher). In other words, a large enough value must be set in VGN1 so that the VIA does not need to be lowered in machines aimed at high-speed precision. When adjusting, the cutting precision will be better if adjustment is carried out to a degree where overshooting does not occur and a high VIA is maintained, without pursuing position droop smoothness.
If there are no vibration or overshooting problems, the high-speed contour cutting precision can be further improved by setting the VIA higher than the standard value. In this case, adjust by raising the VIA in increments of approx. 100 from the standard value.
Setting a higher VIA improves the trackability regarding position commands in machines for which cycle time is important, and the time to when the position droop converges on the in-position width is shortened.
It is easier to adjust the VIA to improve precision and cycle time if a large value (a value near the standard value) can be set in VGN1, or if VGN1 can be raised equivalently using the disturbance observer.

No.	Abbrev.	Parameter name	Explanation	Setting range
SV008	VIA	Speed loop leading compensation	1364 is set as a standard. 1900 is set as a standard during SHG control. Adjust in increments of approx. 100. Raise the VIA and adjust to improve the contour tracking precision in high-speed cutting. If the position droop vibrates (10 to 20Hz), lower the VIA and adjust.	1 to 9999 (0.0687rad/s)

POINT Position droop vibration of 10Hz or less is not leading compensation control vibration. The position loop gain must be adjusted.

10-2-3 Position loop gain

(1) Setting the position loop gain

The position loop gain (SV003:PGN1) is a parameter that determines the trackability to the command position. 47 (SHG control) is set as a standard. Set the same position loop gain value between interpolation axes.

When PGN1 is raised, the position tracking will improve, and the settling time will be shortened, but a speed loop that has a responsiveness that can track the position loop gain with increased response will be required. If the speed loop responsiveness is insufficient, several Hz of vibration or overshooting will occur during acceleration/deceleration. Vibration or overshooting will also occur when VGN1 is smaller than the standard value during VIA adjustment, but the vibration that occurs in the position loop is generally 10Hz or less. (The VIA vibration that occurs is 10 to 20Hz.)

When the position control includes machine resonance points (Position control machine resonance points occur at the machine end parts, etc.) because of insufficient machine rigidity, the machine will vibrate during positioning, etc. In either case, lower PGN1 and adjust so vibration does not occur.

If the machine also vibrates due to machine backlash when the motor stops, the vibration can be suppressed by lowering the PGN1 and smoothly stopping.

If SHG control is used, an equivalently high position loop gain can be maintained while suppressing these vibrations. To adjust the SHG control, gradually raise the gain from a setting where 1/2 of a normal control PGN1 where vibration did not occur was set in PGN1. If the PGN1 setting value is more than 1/2 of the normal control PGN1 when SHG control is used, there is an improvement effect in position control. (Note that for the settling time, the improvement effect is at $1/\sqrt{2}$ or more.)

No.	Abbrev.	Parameter name	Explanation	Setting range
SV003	PGN1	Position loop gain 1	Set 47 as a standard. If PGN1 is increased, the settling time will be shortened, but a sufficient speed loop response will be required.	1 to 200 (rad/s)
SV004	PGN2	Position loop gain 2	Set 125 as a standard. (For SHG control)	0 to 999
SV057	SHGC	SHG control gain	Set 281 as a standard. (For SHG control)	0 to 1200

CAUTION Always set the same value for position loop gain between interpolation axes.

(2) Setting the position loop gain for spindle synchronous control

During spindle synchronous control (synchronous tapping control, etc.), there are three sets of position loop gain parameters besides the normal control.

No.	Abbrev.	Parameter name	Explanation		Setting range
SV049	PGN1sp	Position loop gain 1 during spindle synchronization	Set 15 as a standard.	Set the same parameter as the position loop gain for the spindle synchronous control.	1 to 200 (rad/s)
SV050	PGN2sp	Position loop gain 2 during spindle synchronization	Set 0 as a standard. (For SHG control)		0 to 999
SV058	SHGCsp	SHG control gain during spindle synchronization	Set 0 as a standard. (For SHG control)		0 to 1200

CAUTION Always set the same value for the position loop gain between the spindle and servo synchronous axes.

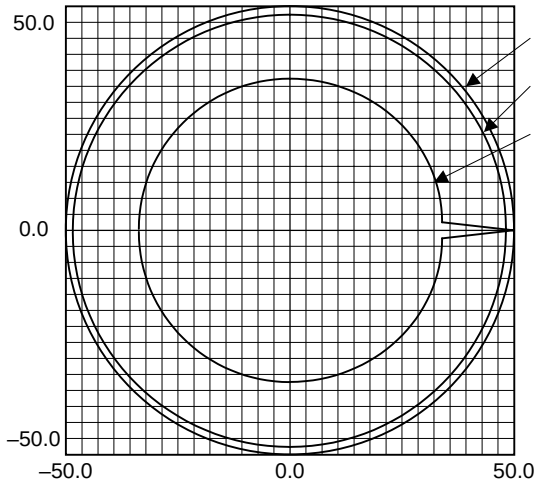
(3) SHG control (option function)

If the position loop gain is increased or feed forward control (CNC function) is used to shorten the settling time or increase the precision, the machine system may vibrate easily.
SHG control changes the position loop to a high-gain by stably compensating the servo system position loop through a delay. This allows the settling time to be reduced and a high precision to be achieved.

(Feature 1) When the SHG control is set, even if PGN1 is set to the same value as the conventional gain, the position loop gain will be doubled.

(Feature 2) The SHG control response is smoother than conventional position control during acceleration/deceleration, so the gain can be increased further with SHG control compared to the conventional position control.

(Feature 3) With SHG control, a high gain is achieved so a high precision can be obtained during contour control.
The following drawing shows an example of the improvement in roundness characteristics with SHG control.



(F=3000mm/min, ERROR=5.0μm/div)

<Effect>

Control method	Roundness error (μm)
SHG control	2.5
Conventional control	22.5

Shape error characteristics

During SHG control, PGN1, PGN2 and SHGC are set with the following ratio.

$$PGN1 : PGN2 : SHGC = 1 : \frac{8}{3} : 6$$

During SHG control even if the PGN1 setting value is the same, the actual position loop gain will be higher, so the speed loop must have a sufficient response. If the speed loop response is low, vibration or overshooting could occur during acceleration/deceleration in the same manner as conventional control. If the speed loop gain has been lowered because machine resonance occurs, lower the position loop gain and adjust.

No.	Abbrev.	Parameter name	Setting ratio	Setting example					Explanation	Setting range
SV003 (SV049)	PGN1 (PGN1sp)	Position loop gain 1	1	23	26	33	38	47	Always set a combination of the three parameters.	1 to 200
SV004 (SV050)	PGN2 (PGN2sp)	Position loop gain 2	8/3	62	70	86	102	125		0 to 999
SV057 (SV058)	SHGC (SHGCsp)	SHG control gain	6	140	160	187	225	281		0 to 1200
SV008	VIA	Speed loop leading compensation	Set 1900 as a standard for SHG control.							1 to 9999
SV015	FFC	Acceleration feed forward gain	Set 100 as a standard for SHG control.							0 to 999

POINT

The SHG control is an optional function. If the option is not set in the CNC, the alarm 37 (at power ON) or warning E4, Error Parameter No. 104 (2304 for M50/M64 Series CNC) will be output.

10-3 Characteristics improvement

10-3-1 Optimal adjustment of cycle time

The following items must be adjusted to adjust the cycle time. Refer to the Instruction Manuals provided with each CNC for the acceleration/deceleration pattern.

1) Rapid traverse rate (rapid) : This will affect the maximum speed during positioning.
2) Clamp speed (clamp) : This will affect the maximum speed during cutting.
3) Acceleration/deceleration time constant (G0t*, G1t*) : Set the time to reach the feedrate.
4) In-position width (SV024) : This will affect each block's movement command end time.
5) Position loop gain (SV003) : This will affect each block's movement command settling time.

(1) Adjusting the rapid traverse rate

To adjust the rapid traverse, the CNC axis specification parameter rapid traverse rate (rapid) and acceleration/deceleration time constant (G0t*) are adjusted. The rapid traverse rate is set so that the motor speed matches the machine specifications in the range below the maximum speed in the motor specifications. For the acceleration/deceleration time constants, carry out rapid traverse reciprocation operation, and set so that the maximum current command value at acceleration/deceleration is within the range shown below.
When adjusting, watch the current FB waveform during acceleration/deceleration, and adjust so that the thrust is within the specified range. Be careful, as insufficient thrust can easily occur when the driver input voltage is low (170 to 190V), and an excessive error can easily occur during acceleration/deceleration.

(2) Adjusting the cutting rate

To adjust the cutting rate, the CNC axis specification parameter clamp speed (clamp) and acceleration/deceleration time constant (G1t*) are adjusted. The in-position width at this time must be set to the same value as actual cutting.

• Determining the clamp rate and adjusting the acceleration/deceleration time constant

(Features) The maximum cutting rate (clamp speed) can be determined freely.
(Adjustment) Carry out cutting feed reciprocation operation with no dwell at the maximum cutting rate and adjust the acceleration/deceleration time constant so that the maximum current command value during acceleration/deceleration is within the range shown below.

• Setting the step acceleration/deceleration and adjusting the clamp speed

(Features) The acceleration/deceleration time constant is determined with the position loop in the servo, so the acceleration/deceleration FΔT can be reduced.
(Adjustment) Set 1 (step) for the acceleration/deceleration time constant and carry out cutting feed reciprocation operation with no dwell. Adjust the cutting feed rate so that the maximum current command value during acceleration/deceleration is within the range shown below, and then set the value in the clamp speed.

Self-cooling		Oil-cooling	
Motor type	**Max. current command value**	**Motor type**	**Max. current command value**
LM-NP2S-05M	600 to 680%	LM-NP2S-05M	270 to 310%
LM-NP2M-10M	590 to 670%	LM-NP2M-10M	275 to 310%
LM-NP2L-15M	565 to 640%	LM-NP2L-15M	270 to 306%
LM-NP4S-10M	590 to 670%	LM-NP4S-10M	275 to 312%
LM-NP4M-20M	550 to 620%	LM-NP4M-20M	262 to 300%
LM-NP4L-30M	570 to 650%	LM-NP4L-30M	272 to 310%
LM-NP4G-40M	560 to 640%	LM-NP4G-40M	271 to 307%

(3) Adjusting the in-position width

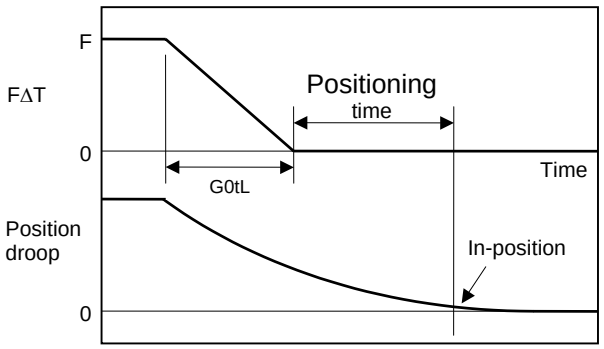
Because there is a response delay in the servomotor drive due to position loop control, a "settling time" is also required for the motor to actually stop after the command speed from the CNC reaches 0. The movement command in the next block is generally started after it is confirmed that the machine has entered the "in-position width" range set for the machine.
Set the accuracy required of the machine for the in-position width. If an unnecessarily high accuracy is set, the cycle time will increase due to a delay in the settling time.
The in-position width is effective even when the standard servo parameters are set. However, it may follow the CNC parameters, so refer to the CNC Instruction Manual for the setting.

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV024	INP	In-position detection width	μm	Set 50 as a standard. Set the precision required for the machine.	0 to 32767

POINT The in-position width setting and confirmation availability depend on the CNC parameters

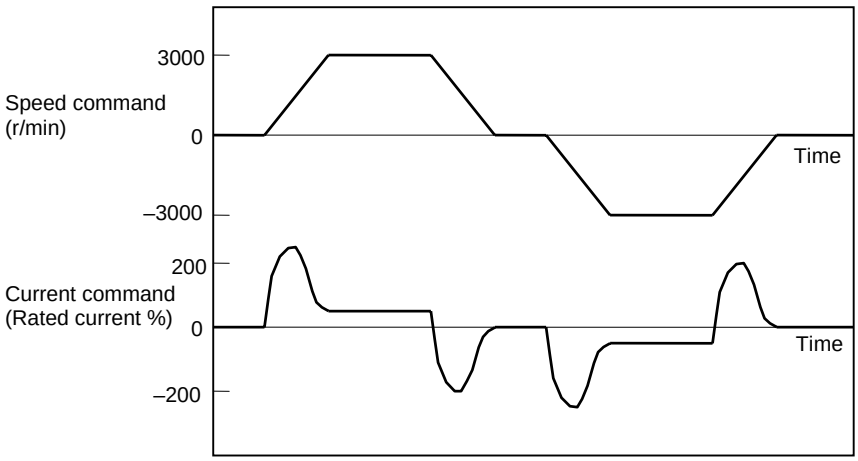
(4) Adjusting the settling time

The settling time is the time required for the position droop to enter the in-position width after the feed command (FΔT) from the CNC reaches 0.
The settling time can be shortened by raising the position loop gain or using SHG control. However, a sufficient response (sufficiently large VGN1 setting) for the speed loop is required to carry out stable control.
The settling time during normal control when the CNC is set to linear acceleration/ deceleration can be calculated using the following equation. During SHG control, estimate the settling time by multiplying PGN1 by $\sqrt{2}$.



$$\text{Settling time (ms)} = -\frac{10^3}{\text{PGN1}} \times \lambda n \left(\frac{\text{INP}}{\frac{F \times 10^6}{60 \times \text{G0tL} \times \text{PGN1}^2} \times 1 - \left\{ \exp\left(-\frac{\text{PGN1} \times \text{G0tL}}{10^3} \right) \right\}} \right)$$

PGN1 : Position loop gain1 (SV003) (rad/s)
F : Rapid traverse rate (mm/min)
G0tL : Rapid traverse linear acceleration/ deceleration time constant (ms)
INP : In-position width (SV024) (μm)



Example of speed/current command waveform during acceleration/deceleration

10-3-2 Vibration suppression measures

If vibration (machine resonance) occurs, it can be suppressed by lowering the speed loop gain (VGN1). However, cutting precision and cycle time will be sacrificed. (Refer to "10-2-2 Speed loop gain".) Thus, try to maintain the VGN1 as high as possible, and suppress the vibration using the vibration suppression functions.
If the VGN1 is lowered and adjusted because vibration cannot be sufficiently suppressed with the vibration suppression functions, adjust the entire gain (including the position loop gain) again.

<Examples of vibration occurrence>

- A fine vibration is felt when the machine is touched, or a groaning sound is heard.
- Vibration or noise occurs during rapid traverse.

POINT

Suppress the vibration using the vibration (machine resonance) suppression functions, and maintain the speed loop gain (SV005: VGN1) as high as possible.

(1) Machine resonance suppression filter

The machine resonance suppression filter will function at the set frequency. Use the D/A output function to output the current feedback and measure the resonance frequency. Note that the resonance frequency that can be measured is 0 to 500 Hz. For resonance exceeding 500 Hz, directly measure the phase current with a current probe, etc.
When the machine resonance suppression filter is set, vibration may occur at a separate resonance frequency that existed latently at first. In this case, the servo control is stabilized when the machine resonance suppression filter depth is adjusted and the filter is adjusted so as not to operate more than required.

<Setting method>

1. Set the resonance frequency in the machine resonance suppression filter frequency (SV038: FHz1, SV046: FHz2).
2. If the machine starts to vibrate at another frequency, raise (make shallower) the machine resonance suppression filter depth compensation value (SV033: SSF2.nfd), and adjust to the optimum value at which the resonance can be eliminated.
3. When the vibration cannot be completely eliminated, use another vibration suppression control (jitter compensation, adaptive filter) in combination with the machine resonance suppression filter.

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV038	FHz1	Machine resonance suppression filter center frequency 1	Hz	Set the resonance frequency to be suppressed. (Valid at 36 or more). Set 0 when the filter is not to be used.	0 to 9000 (Hz)
SV046	FHz2	Machine resonance suppression filter center frequency 2	Hz	Set the resonance frequency to be suppressed. (Valid at 36 or more). Set 0 when the filter is not to be used.	0 to 9000 (Hz)
SV033	SSF2	Special servo function selection 2	The machine resonance suppression filter depth compensation is set with the following parameters.		

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
dos				dis				nfd2			nfd3	nfd1			zck

bit		Explanation
0 to 3	nfd1	Set the filter depth for the 1st machine resonance suppression filter. The control stability can be improved by setting amount equivalent to the resonance elimination amount. Deeper ← → Shallower Setting value 000 001 010 011 100 101 110 111 Depth (dB) −∞ −18 −12 −9 −6 −4 −3 −1
4	nfd3	The 3rd machine resonance suppression filter is validated. (Center frequency 1125Hz)
5 to 7	nfd2	Set the filter depth for the 2nd machine resonance suppression filter. The control stability can be improved by setting amount equivalent to the resonance elimination amount. Deeper ← → Shallower Setting value 000 001 010 011 100 101 110 111 Depth (dB) −∞ −18 −12 −9 −6 −4 −3 −1

(2) Adaptive filter (option function)

The servo driver detects the machine resonance point and automatically sets the filter constant. Even if the ball screw and table position relation changes causing the resonance point to change, the filter will track these changes.
Set the special servo function selection 1 (SV027: SSF1) bit 15 to activate the adaptive filter.
If the adaptive filter's sensitivity is low and the machine resonance cannot be suppressed, set the (SV027: SSF1) bit 12 and 13.

No.	Abbrev.	Parameter name	Explanation
SV027	SSF1	Special servo function selection 1	Activate the adaptive filter by setting the following parameters.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
aflt	zrn2	afrg	afse	ovs2	ovs1	lmc2	lmc1	omr		vfct2	vfct1		upc	vcnt2	vcnt1

bit		Meaning when "0" is set.	Meaning when "1" is set.
15	aflt	Adaptive filter stopped	Adaptive filter activated
13	afrg	00 : Normal adaptive filter sensitivity	11 : Increased adaptive filter sensitivity
12	afse		

POINT

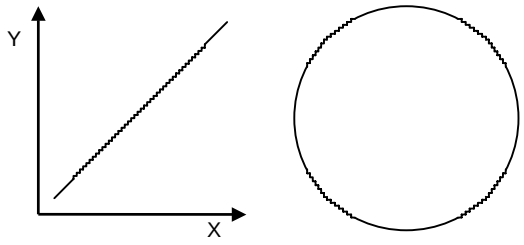
The adaptive filter is an optional function. If the option is not set in the CNC, alarm 37 (at power ON) or warning E4 Error Parameter No. 105 (2305 for M50/M64 Series CNC) will be output.

10-3-3 Improving the cutting surface precision

If the cutting surface precision or roundness is poor, improvements can be made by increasing the speed loop gain (VGN1, VIA) or by using the disturbance observer function.

<Examples of faults>

- The surface precision in the 45° direction of a taper or arc is poor.
- The load fluctuation during cutting is large, causing vibration or surface precision defects to occur.



POINT

Adjust by raising the speed loop gain equivalently to improve cutting surface precision, even if the measures differ. In this case, it is important how much the machine resonance can be controlled, so adjust making sufficient use of vibration suppression functions.

(1) Adjusting the speed loop gain (VGN1)

If the speed loop gain is increased, the cutting surface precision will be improved but the machine will resonate easily.
The final VGN1 setting should be approx. 70 to 80% of the maximum value where resonance does not occur.
(Refer to "10-2-2 (1) Setting the speed loop gain")

(2) Adjusting the speed loop leading compensation (VIA)

The VIA has a large influence on the position trackability, particularly during high-speed cutting (generally F1000 or more). Raising the setting value improves the position trackability, and the contour precision during high-speed cutting can be improved. For high-speed high-precision cutting machines, adjust so that a value equal to or higher than the standard value can be set.
When the VIA is set lower than the standard value and set to a value differing between interpolation axes, the roundness precision may become worse (the circle may distort). This is due to differences occurring in the position trackability between interpolation axes. The distortion can be improved by matching the VIA with the smaller of the values. Note that because the position trackability is not improved, the surface precision will not be improved.
(Refer to "10-2-2 (2) Setting the speed loop leading compensation")

No.	Abbrev.	Parameter name	Explanation	Setting range
SV005	VGN1	Speed loop gain	Increase the value by 10 to 20% at a time. If the machine starts resonating, lower the value by 20 to 30% at a time. The setting value should be 70 to 80% of the value where resonance does not occur.	1 to 999
SV008	VIA	Speed loop leading compensation	1364 is set as a standard. 1900 is set as a standard during SHG control. Adjust in increments of approx. 100. Raise the VIA and adjust to improve the contour tracking precision in high-speed cutting. If the position droop vibrates (10 to 20Hz), lower the VIA and adjust.	1 to 9999 (0.0687rad/s)

(3) Disturbance observer

The disturbance observer can reduce the effect caused by disturbance, frictional resistance or torsion vibration during cutting by estimating the disturbance thrust and compensating it. It also is effective in suppressing the vibration caused by speed leading compensation control.

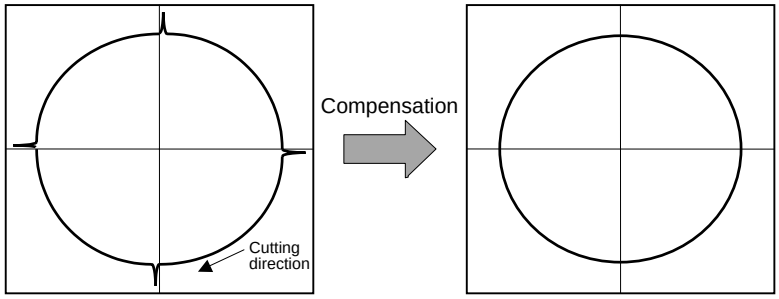
<Setting method>

1) Adjust VGN1 to the value where vibration does not occur, and then lower it 10 to 20%.
2) Set the total movable mass (including motor mass) (SV037: JL).
3) Set the observer filter band (observer pole) in the disturbance observer 1 (SV043:OBS1), and estimate the high frequency disturbance to suppress the vibration. Set 600 as a standard.
4) Set the observer gain in disturbance observer 2 (SV044:OBS2). The disturbance observer will function here for the first time. Set 100 first, and if vibration does not occur, increase the setting by 50 at a time to increase the observer effect.
5) If vibration occurs, lower OBS1 by 50 at a time. The vibration can be eliminated by lowering OBS2, but the effect of the disturbance observer can be maintained by keeping OBS2 set to a high value.

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV037	JL	Total movable mass	kg	Set the total mass of the moving section with a kg unit. (Including the motor mass)	0 to 5000 (kg)
SV043	OBS1	Disturbance observer 1	rad/s	Set the observer filter band (observer pole). Set 600 as a standard, and lower the setting by 50 at a time if vibration occurs.	0 to 1000 (rad)
SV044	OBS2	Disturbance observer 2	%	Set the observer gain. Set 100 to 300 as a standard, and lower the setting if vibration occurs.	0 to 500 (%)

10-3-4 Improvement of protrusion at quadrant changeover

The response delay (caused by non-sensitive band from friction, torsion, expansion/contraction, backlash, etc.) caused when the machine advance direction reverses is compensated with the lost motion compensation (LMC compensation) function.
With this, the protrusions that occur with the quadrant changeover in the DBB measurement method, or the streaks that occur when the quadrant changes during circular cutting can be improved.



Circle cutting path before compensation **Circle cutting path after compensation**

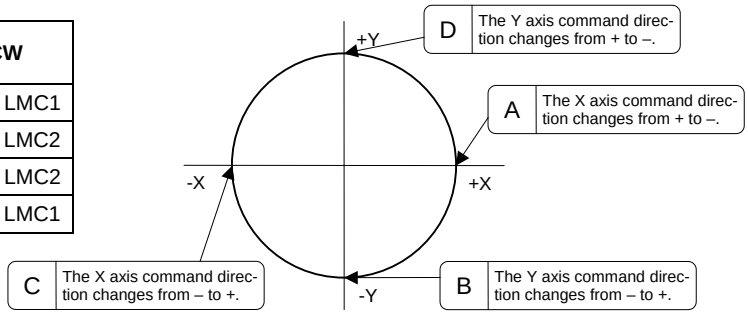
(1) Lost motion compensation (LMC compensation)

The lost motion compensation compensates the response delay during the reversal by adding the torque command set with the parameters when the speed direction changes. There are two methods for lost motion compensation. Type 2 is the standard method.
(The explanation for type 1 method is omitted because it is interchangeable with the old method.)

<Setting method>

1) Set the special servo function selection 1 (SV027:SSF1) bit 9. (The LMC compensation type 2 will start).
2) Set the compensation amount with a stall % (rated current % for the general-purpose motor) unit in the lost motion compensation 1 (SV016:LMC1). The LMC1 setting value will be used for compensation in the positive and negative directions when SV041:LMC2 is 0.
3) If the compensation amount is to be changed in the direction to be compensated, set LMC2. The compensation direction setting will be as shown below with the CW/CCW setting in the CNC parameter. If only one direction is to be compensated, set the side not to be compensated as -1.

Compensation point	CW	CCW
A	X axis: LMC2	X axis: LMC1
B	Y axis: LMC1	Y axis: LMC2
C	X axis: LMC1	X axis: LMC2
D	Y axis: LMC2	Y axis: LMC1



No.	Abbrev.	Parameter name	Explanation
SV027	SSF1	Special servo function selection 1	The lost motion compensation starts with the following parameter.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
aflt	zrn2	afrg	afse	ovs2	ovs1	lmc2	lmc1	omr		vfct2	vfct1		upc	vcnt 2	vcnt 1

bit		No LMC	LMC type 1	LMC type 2	Setting prohibited.
8	lmc1	0	1	0	1
9	lmc2	0	0	1	1

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV016	LMC1	Lost motion compensation 1	Stall % (rated current %)	While measuring the quadrant protrusion amount, adjust with a 5% unit. The ± direction setting value will be applied when LMC2 is set to 0.	–1 to 200 (%)
SV041	LMC2	Lost motion compensation 2	Stall % (rated current %)	Set 0 as a standard. Set this when the compensation amount is to be changed according to the direction.	–1 to 200 (%)

<Adjustment method>

First confirm whether the axis to be compensated is an unbalance axis (vertical axis, slant axis). If it is an unbalance axis, carry out the adjustment after performing step "(2) Unbalance thrust compensation".
Next, measure the frictional torque. Carry out reciprocation operation (approx. F1000) with the axis to be compensated and measure the load current % when fed at a constant speed on the CNC servo monitor screen. The frictional force of the machine at this time is expressed with the following expression.

$$\text{Frictional force \%} = \left| \frac{(+\text{ feed load current \%}) - (-\text{ feed load current \%})}{2} \right|$$

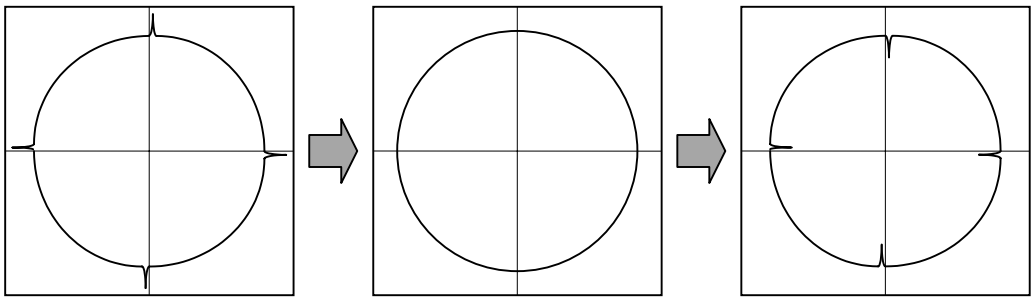
The standard setting value for the lost motion compensation 1 (LMC1) is double the frictional torque above.

(Example)

Assume that the load current % was 25% in the + direction and –15% in the – direction when JOG feed was carried out at approx. F1000. The frictional force is as shown below, so 20% × 2 = 40% is set for LMC1. (LMC2 is left set at 0.) With this setting, 40% compensation will be carried out when the command reverses from the + direction to the - direction, and when the command reverses from the – direction to the + direction.

$$\left| \frac{25 - (-15)}{2} \right| = 20\%$$

For the final adjustment, measure the CNC sampling measurement (DBB measurement) or while carrying out actual cutting. If the compensation amount is insufficient, increase LMC1 or LMC2 by 5% at a time. Note that if the setting is too high, biting may occur.



Compensation 0 **Optimum** **Too high**

POINT

1. When either parameter SV016: LMC1 or SV041: LMC2 is set to 0, the same amount of compensation is carried out in both the positive and negative direction with the setting value of the other parameter (the parameter not set to 0).
2. To compensate in only one direction, set -1 in the parameter (LMC1 or LMC2) for the direction in which compensation is prohibited.
3. The value set based on the frictional force is the standard value for LMC compensation. The optimum compensation amount changes with the cutting conditions (cutting speed, cutting radius, blade type, workpiece material, etc.). Be sure to ultimately make test cuts matching the target cutting and determine the compensation amount.

(2) Unbalance thrust compensation

If the load force differs in the positive and negative directions such as with a vertical axis or slant axis, the thrust offset (SV032:TOF) is set to carry out accurate lost motion compensation.

<Setting method>

Measure the unbalance thrust. Carry out reciprocation operation (approx. F1000) with the axis to be compensated and measure the load current % when fed at a constant speed on the CNC servo monitor screen. The unbalance thrust at this time is expressed with the following expression.

$$\text{Unbalance thrust} = \left| \frac{(+\text{ feed load current \%}) - (-\text{ feed load current \%})}{2} \right|$$

The unbalance thrust value above is set for the thrust offset (TOF).
If there is a difference in the protrusion amount according to the direction, make an adjustment with LMC2. Do not adjust with TOF.

(Example)

Assume that the load current % was −40% in the + direction and −20% in the – direction when JOG feed was carried out at approx. F1000. The unbalance thrust is as shown below, so −30% is set for TOF.

$$\left| \frac{-40 + (-20)}{2} \right| = 30\%$$

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV032	TOF	Thrust offset	Stall % (rated current %)	Set this when carrying out lost motion compensation. Set the unbalance thrust amount.	–100 to 100

POINT

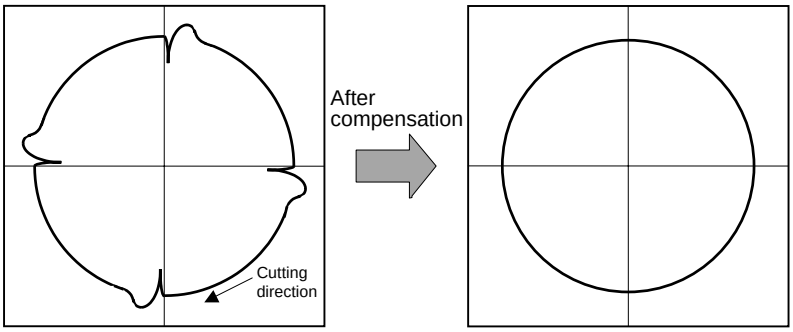
Even when TOF is set, the thrust output characteristics of the motor and load current display of the CNC servo monitor will not change.
Only LMC compensation characteristics are affected.

(3) Adjusting the lost motion compensation timing

If the speed loop gain has been lowered from the standard setting value because the machine rigidity is low or because machine resonance occurs easily, or when cutting at high speeds, the quadrant protrusion may appear later than the quadrant changeover point on the servo control. In this case, suppress the quadrant protrusion by setting the lost motion compensation timing (SV039: LMCD) to delay the LMC compensation.

<Adjustment method>

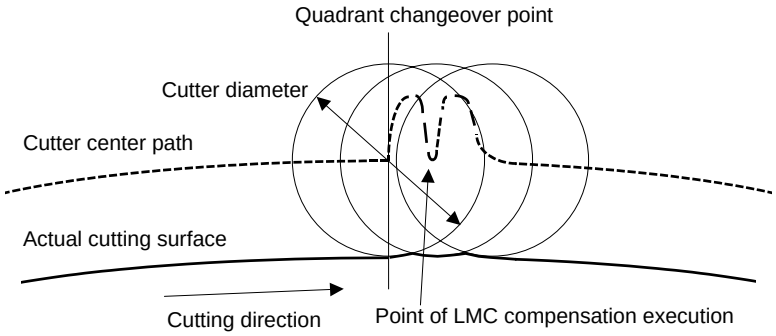
If a delay occurs in the quadrant protrusion in the circle or arc cutting as shown below in respect to the cutting direction when CNC sampling measurement (DBB measurement) or actual cutting is carried out, and the compensation appears before the protrusion position, set the lost motion compensation timing (SV039:LMCD).
While measuring the arc path, increase LMCD by 10ms at a time, to find the timing that the protrusion and compensation position match.



Before timing delay compensation **After timing delay compensation**

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV039	LMCD	Lost motion compensation timing	ms	Set this when the lost motion compensation timing does not match. Adjust while increasing the value by 10 at a time.	0 to 2000 (ms)

When the LMCD is gradually raised, a two-peaked contour may occur at the motor FB position DBB measurement. However, due to the influence of the cutter diameter in cutting such as end milling, the actual cutting surface becomes smooth.
Because satisfactory cutting can be achieved even if this two-peaked contour occurs, consider the point where the protrusion becomes the smallest and finest possible without over compensating (bite-in) as the optimum setting.



(4) Adjusting for feed forward control

In LMC compensation, a model position considering the position loop gain is calculated based on the position command sent from the CNC, and compensation is carried out when the feed changes to that direction. When the CNC carries out feed forward (fwd) control, overshooting equivalent to the operation fraction unit occurs in the position commands, and the timing of the model position direction change may be mistaken. As a result, the LMC compensation timing may deviate, or compensation may be carried out two or more times.
If feed forward control is carried out and the compensation does not operate correctly, adjust with the non-sensitive band (SV040: LMCT) during feed forward control. In this non-sensitive band control, overshooting of a set width or less is ignored. The model position direction change point is correctly recognized, and the LMC compensation is correctly executed.
This parameter is meaningless when feed forward control is not being carried out.

<Adjustment method>

If the compensation timing deviates during feed forward control, increase the LMCT setting by 1μm at a time.
Note that 2μm are set even when the LMCT is set to 0.

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV040	LMCT	Non-sensitive band during feed forward control	μm	This setting is valid only during feed forward control. 2 μm is set when this is set to 0. Adjust by increasing the value by 1 μm at a time.	0 ~ 100 (μm)

POINT

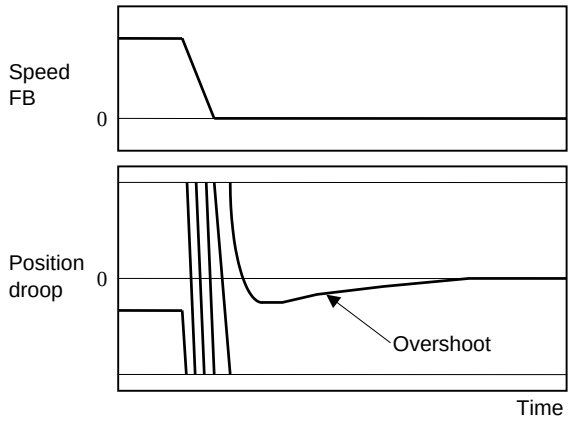
Setting of the non-sensitive band (SV040: LMCT) during feed forward control is effective for improving overshooting compensation mis-operation during feed forward control.

10-3-5 Improvement of overshooting

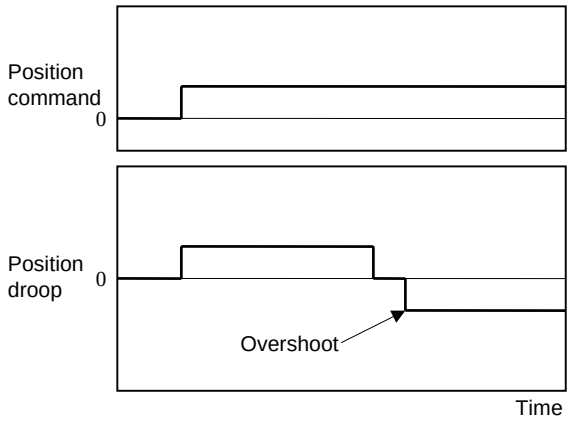
The phenomenon when the machine position goes past or exceeds the command during feed stopping is called overshooting. Overshooting is compensated by overshooting compensation (OVS compensation).
Overshooting occurs due to the following two causes.

1) Machine system torsion: Overshooting will occur mainly during rapid traverse positioning
2) Machine system friction: Overshooting will occur mainly during one pulse feed

Either phenomenon can be confirmed by measuring the position droop.



1) Overshooting during rapid traverse positioning



2) Overshooting during pulse feed

(1) Overshooting compensation (OVS compensation)

In OVS compensation, the overshooting is suppressed by subtracting the thrust command set in the parameters when the motor stops. There are two types of OVS compensation. The standard method is type 2.
OVS compensation type 3 has a compensation effect for the overshooting during either rapid traverse positioning or pulse feed. Note that there is no compensation if the next feed command has been issued before the motor positioning (stop). (Therefore, there is no compensation during circle cutting.) There is no compensation in the non-sensitive band when the CNC is carrying out feed forward control. To compensate overshooting during feed forward control, refer to the following section "(2) Adjusting for feed forward control".

<Setting and adjustment methods>

1) Set the special servo function selection 1 (SV027:SSF1) bit 11 (ovs2). (OVS compensation type 2 will start.)
2) Observe the position droop waveform using the D/A output, and increase the overshoot compensation 1 (SV031: OVS1) value 1% at a time. Set the smallest value where the overshooting does not occur. If SV042:OVS2 is 0, the overshooting will be compensated in both the positive/negative directions with the OVS1 setting value.
3) If the compensation amount is to be changed in the direction to be compensated, set the + direction compensation value in OVS1 and the – direction compensation value in OVS2. If only one direction is to be compensated, set the side not to be compensated as -1. The compensation direction setting will be as reversed with the CNC parameter CW/CCW setting.

POINT

In OVS compensation type 2, there is no compensation in the following cases.
1. There is no compensation if the next feed command has been issued before the motor positioning (stop). (There is no compensation in circle cutting.)
2. There is no compensation when the CNC is carrying out feed forward (fwd) control.

(2) Adjusting for feed forward control

Use OVS compensation type 3 if overshooting is a problem in contour cutting during feed forward control.
If OVS compensation type 3 is used to attempt to compensate overshooting, the overshooting may conversely become larger, or projections may appear during arc cutting. This is because overshooting equivalent to the operation fraction unit occurs in the position commands when the CNC is carrying out feed forward (fwd) control. Because of this, the OVS compensation recognizes a change in the command direction, and executes the compensation in the opposite direction.
If the compensation is in the opposite direction when carrying out feed forward control, adjust with the non-sensitive band (SV034: SSF3 bit12 to 15: ovsn) during feed forward control. By ignoring overshooting of a set width in the ovsn or less, the command direction change point is correctly recognized, and the OVS compensation is correctly executed.
This parameter is insignificant when feed forward control is not used.

<Adjustment method>

If the OVS compensation is carried out in reverse during feed forward control, increase the LMCT setting by 1µm at a time.
Note that 2µm are set even when the LMCT is set to 0.

POINT OVS compensation type 3 is used if overshooting is a problem with contour cutting during feed forward control.

No.	Abbrev.	Parameter name	Explanation
SV027	SSF1	Special servo function selection 1	The overshooting compensation starts with the following parameter.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
aflt	zrn2	afrg	afse	ovs2	ovs1	lmc2	lmc1	omr		vfct2	vfct1		upc	vcnt 2	vcnt 1

bit		Meaning when "0" is set.	Meaning when "1" is set.
10	ovs1	Overshooting compensation type 2 stop	Overshooting compensation type 2 start
11	ovs2	Overshooting compensation type 3 stop	Overshooting compensation type 3 start

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV031	OVS1	Overshooting compensation 1	Stall % (rated current %)	Increase the value by 1% at a time, and find the value where overshooting does not occur. When OVS2 is set to 0, the setting value will be applied in both the ± directions.	–1 to 100 (%)
SV042	OVS2	Overshooting compensation 2	Stall % (rated current %)	Set 0 as a standard. Set this when the compensation amount is to be changed according to the direction.	–1 to 100 (%)

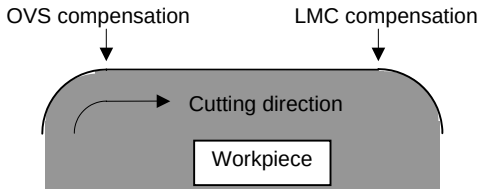
No.	Abbrev.	Parameter name	Explanation
SV034	SSF3	Special servo function selection 3	The overshooting compensation starts with the following parameter.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ovsn				linN				toff	os2		dcd	test	mohn	has2	has1

bit		Explanation
12	ovsn	Set the non-sensitive band for the overshooting compensation type 3.
13		
14		
15		

POINT

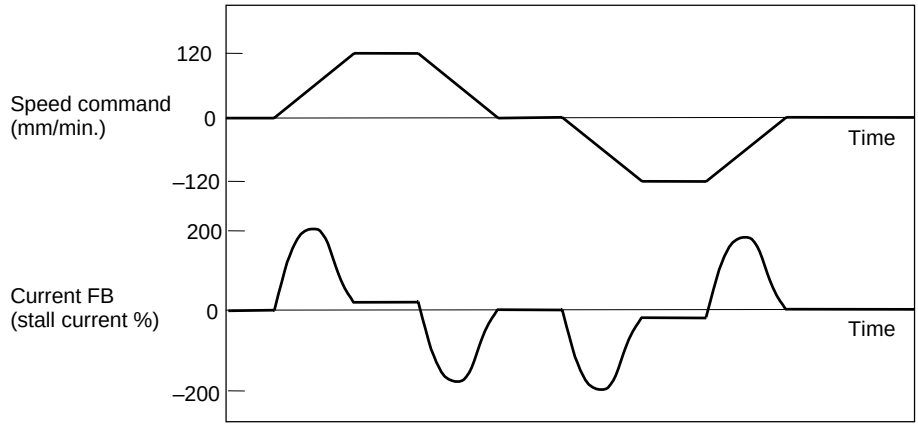
1. When either parameter SV031: OVS1 or SV042: OVS2 is set to 0, the same amount of compensation is carried out in both the positive and negative direction, using the setting value of the other parameter (the parameter not set to 0).
2. To compensate in only one direction, set -1 in the parameter (OVS1 or OVS2) for the direction in which compensation is prohibited.
3. For contour cutting, the projection at the arc end point is compensated with OVS compensation. LMC compensation is carried out at the arc starting point.



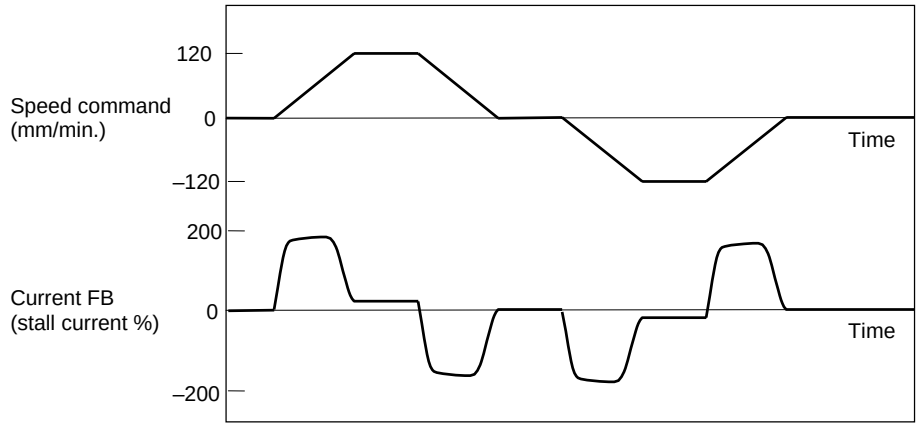
10-3-6 Improvement of characteristics during acceleration/deceleration

(1) SHG control (option function)

Because SHG control has a smoother response than conventional position controls, the acceleration/deceleration thrust (current FB) has more ideal output characteristics (A constant thrust is output during acceleration/deceleration.) The peak thrust is kept low by the same acceleration/deceleration time constant, enabling the time constant to be shortened.
Refer to item "(3) SHG control" in section "10-2-3 Position loop gain" for details on setting SHG control.



Acceleration/deceleration characteristics during conventional control

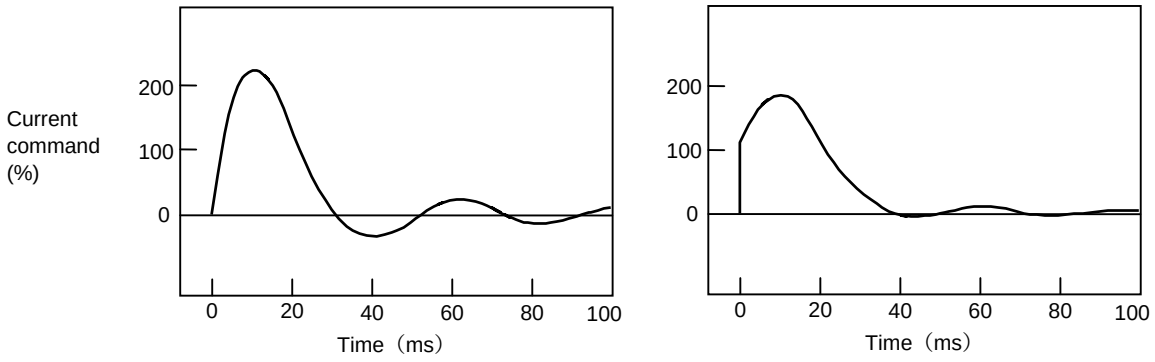


Acceleration/deceleration characteristics during SHG control

No.	Abbrev.	Parameter name	Setting ratio	Setting example					Explanation	Setting range
SV003 (SV049)	PGN1 (PGN1sp)	Position loop gain 1	1	23	26	33	38	47	Always set a combination of 3 parameters.	1 to 200 (rad/s)
SV004 (SV050)	PGN2 (PGN2sp)	Position loop gain 2	$\frac{8}{3}$	62	70	86	102	125		0 to 999
SV057 (SV058)	SHGC (SHGCsp)	SHG control gain	6	140	160	187	225	281		0 to 1200
SV008	VIA	Speed loop leading compensation	Set 1900 as a standard value during SHG control.							1 to 9999
SV015	FFC	Acceleration feed forward gain	Set 100 as a standard value during SHG control.							0 to 999

(2) Acceleration feed forward

Vibration may occur at 10 to 20 Hz during acceleration/deceleration when a short time constant of 30 msec or less is applied, and a position loop gain (PGN1) higher than the general standard value or SHG control is used. This is because the thrust is insufficient when starting or when starting deceleration, and can be resolved by setting the acceleration feed forward gain (SV015:FFC). This is also effective in reducing the peak current (torque).
While measuring the current command waveform, increase FFC by 50 to 100 at a time and set the value where vibration does not occur.



No FFC setting **With FFC setting**

Acceleration feed forward gain means that the speed loop gain during acceleration/deceleration is raised equivalently. Thus, the thrust (current command) required during acceleration/deceleration starts sooner. The synchronization precision will improve if the FFC of the delayed side axis is raised between axes for which high-precision synchronous control (such as synchronous tap control and superimposition control).

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV015	FFC	Acceleration feed forward gain	%	The standard setting value is 0. To improve the acceleration/deceleration characteristics, increase the value by 50 to 100 at a time. During SHG control, the standard setting value is 100.	1 to 999

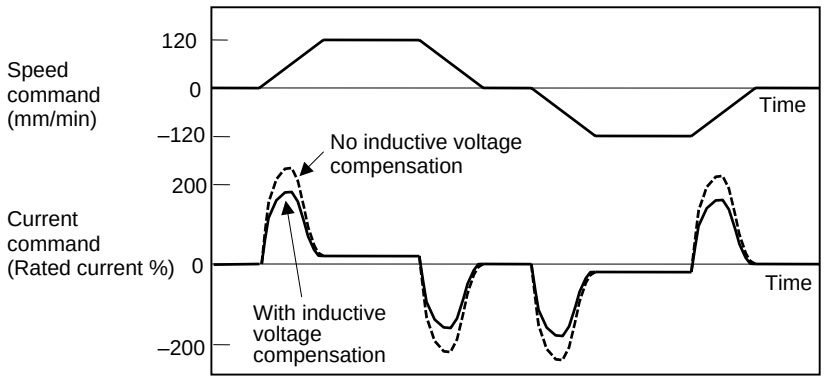
POINT Overshooting occurs easily when a value above the standard value is set during SHG control.

(3) Inductive voltage compensation

The current loop response is improved by compensating the back electromotive force element induced by the motor feedrate. This improved the current command efficiency, and allows the acceleration/deceleration time constant to the shortened.

<Adjustment method>

1) While accelerating/decelerating at rapid traverse, adjust the inductive voltage compensation gain (SV047:EC) so that the current FB peak is a few % smaller than the current command peak.



Inductive voltage compensation

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV047	EC	Inductive voltage compensation gain	%	Set 100% as a standard. Lower the gain if the current FB peak exceeds the current command peak.	0 to 200

POINT

If the current FB peak becomes larger than the current command peak (over compensation), an overcurrent (alarm 3A) will occur easily. Note that over compensation will occur easily if the movable mass is large.

10-4 Setting for emergency stop

10-4-1 Vertical axis drop prevention control

The vertical axis drop prevention control is a function that prevents the vertical axis from dropping due to a delay in the brake operation when an emergency stop occurs. The servo ready OFF will be delayed by the time set in the parameter from when the emergency stop occurs. Thus, the no-control time until the brakes activate can be eliminated.

POINT The CN20 connector on the servo drive unit can be used for mechanical brake control. Refer to section "7-2-12 Connection with mechanical brakes" for details on the connection with mechanical brakes.

(1) Working conditions

1) Emergency stop input : The drive side detects the emergency stop input signal, and enters this function mode.
2) CNC power OFF : The driver detects the power OFF message from the CNC, and enters this operation. (when drive section power is ON)
3) When alarm occurs : Note that the activity of this function differs according to the alarm. (Refer to the Table of driver alarm classes)
4) Input power OFF : Normally, the CNC power OFF signal is detected by the drive side, and this operation is entered in the same manner as item 2). However, in this mode where the input power is suddenly shut off, there may be no effect depending on the operation state of the axis supplied power from the input power voltage and power supply (axis connected with L+, L–).

⚠ CAUTION Note that drop prevention may not be possible in all conditions as noted above. To prevent dropping in all conditions, use a balance unit on the machine side, etc.

(2) Outline of function, and setting of parameters

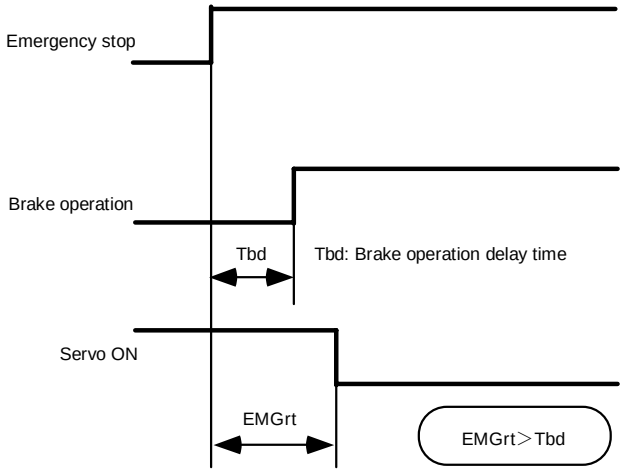
When stopped ····· The driver's READY is turned OFF after the vertical axis drop prevention time (SV048) has passed.

During movement ····· Deceleration stop is carried out, and then the driver's READY is turned OFF after the longer of the vertical axis drop prevention time (SV048) or emergency stop max. delay time (SV055) has passed.

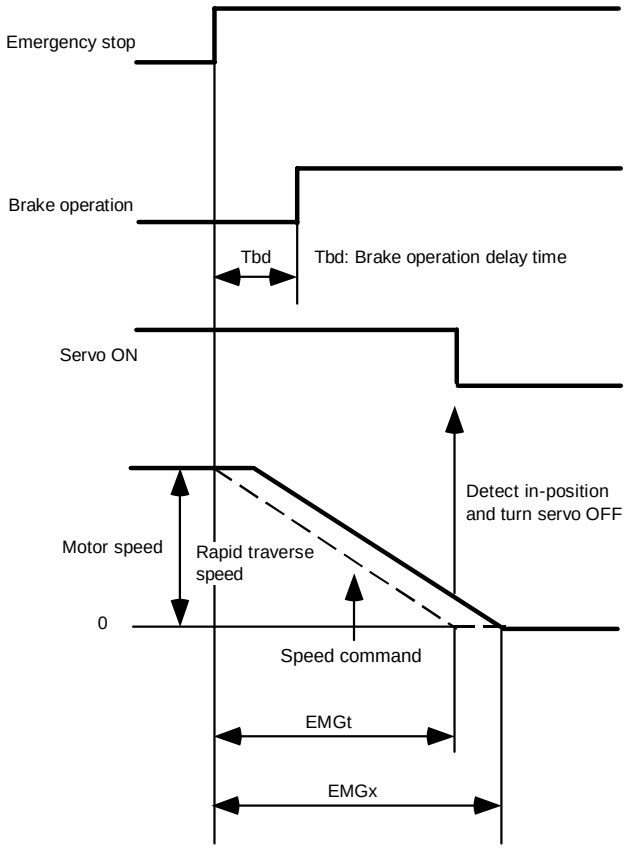
No.	Abbrev.	Name	Details	Setting range
SV048	EMGrt	Vertical axis drop prevention time (ms)	Set the READY OFF delay time at an emergency stop. Set a larger value than the brake operation time. When the input power is OFF, the set vertical axis drop prevention time may not necessarily be guaranteed.	0 to 2000 (ms)
SV055	EMGx	Emergency stop max. delay time (ms)	Set the max. READY OFF delay time. Normally, the same value as SV048 is set. To turn READY OFF after decelerating to a stop, set the same value as SV056. Note that this is valid when SV056 is larger than SV048. If a value smaller than SV048 is input in the parameters, the same value as SV048 will be automatically set. When the input power is OFF, the set max. READY OFF time may not necessarily be guaranteed.	0 to 2000 (ms)
SV056	EMGt	Time constant for deceleration control during emergency stop	When SV048 is set, deceleration stop is carried out during movement, so set this deceleration stop time constant. Set the same value as the rapid traverse time constant. When this parameter is set, constant inclination linear deceleration stop will be carried out at the emergency stop. If 0 is set, step stopping will be carried out.	0 to 2000 (ms)

⚠ CAUTION

1. If 0 is set for both SV048 and SV055, the drop prevention function will be invalidated.
2. SV048 and SV055 are available for each axis, but if the values differ for two axes in the same driver, the larger value will be validated.
3. If only SV048 is set, the deceleration stop will be step stop.



Drop prevention function sequence for emergency stop



Deceleration stop function sequence for emergency stop

(3) Adjustment procedures

- Set the drop prevention function parameters in the vertical axis servo parameters SV048, 055 and 056.

  1) Set the vertical axis parameter SV048 (vertical axis drop prevention time) to 50, 100, ... while carrying out emergency stop, and set the value for which the drop amount is the minimum on the CNC screen. (There will be several um due to the brake play.)
  2) Set SV056 (deceleration control during emergency stop time constant). Normally, set the same value as the rapid traverse time constant.
  3) Set SV055 (emergency stop max. delay time). Normally, set the same value as SV048. To turn READY OFF after deceleration stop, set the same value as SV056. Note that this is valid when SV056 (deceleration control during emergency stop time constant) is larger than SV048 (vertical axis drop prevention time).

- If the axis controlling the power supply (axis to which CN4 cable is connected) that supplies the power to the target vertical axis is another servo axis, set the servo parameters SV048, 055 and 056 for that axis to the same values as the vertical axis. (If there are multiple vertical axes, set the max. value.)

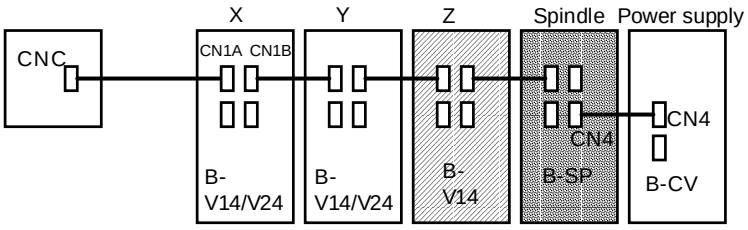
- When the 2-axis driver is a vertical axis or an axis controlling the power supply, set servo parameters SV048, 055 and 056 for both the L and M axes.

- If the axis controlling the power supply is the main axis, confirm that a compatible spindle driver software version is being used, and set the spindle parameter SP033 bitF to 1.

As explained above, when using an axis that controls the power supply or a 2-axis integrated driver, etc., caution must be taken when setting the parameters for each system. The methods for setting the parameters for each drive system are explained on the following pages.

1) When power supply control axis is main axis (Example; When vertical axis is Z axis)

1)-1: When vertical axis is 1-axis driver

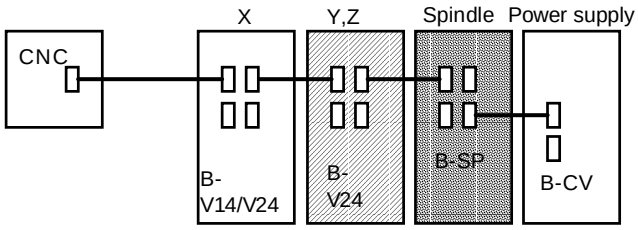


Set in the vertical axis servo parameters SV48, 55 and 56.

If the axis connected to the power supply that is supplying power to the vertical axis is the main axis, this process is required.

Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V14/V24)	Z axis (B-V14)	Spindle (B-SP)
			Vertical axis 1-axis servo driver	Axis connected to power supply
SV48	0	0	Set with adjustments	Spindle software version A5 or above is required. (Set the spindle parameters SP033 bitF to 1.)
SV55	0	0	Set same value as SV48	
SV56	0	0	Set same value as rapid traverse time constant	

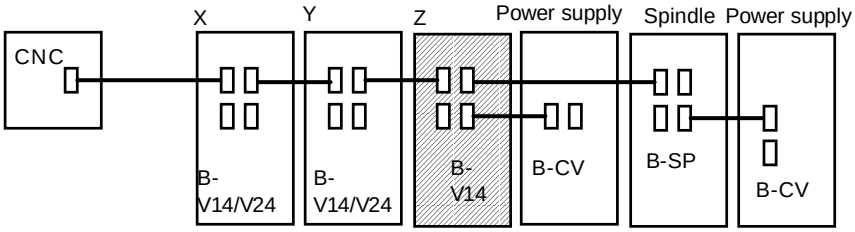
1)-2: When vertical axis is 2-axis driver



Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V24)	Z axis (B-V24)	Spindle (B-SP)
		2-axis servo driver	Vertical axis 2-axis servo driver	Axis connected to power supply
SV48	0	Set same value as Z axis	Set with adjustments	Spindle software version A5 or above is required. (Set the spindle parameters SP033 bitF to 1.)
SV55	0	Set same value as Z axis	Set same value as SV48	
SV56	0	Set same value as rapid traverse time constant	Set same value as rapid traverse time constant	

***** When vertical axis is 2-axis driver, set for both L and M axes.

2) When power supply control axis is vertical axis servo axis (Example: When both vertical axis and axis connected to power supply are Z axis)

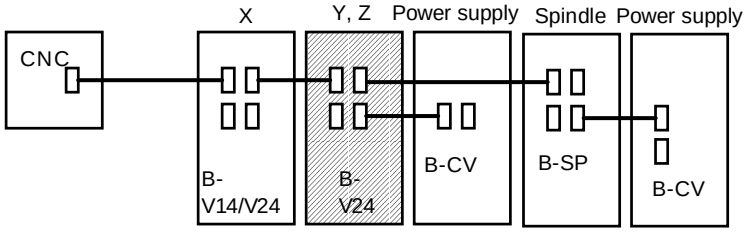


When the vertical axis and axis connected to the power supply are the same driver, only the vertical axis servo parameters need to be set.

2)-1: When vertical axis is 1-axis driver

Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V14/V24)	Z axis (B-V14)	Spindle (B-SP)
			Vertical axis and axis connected to power supply	**Separate power supply connection (only spindle)**
SV48	0	0	Set with adjustments	Does not relay on software.
SV55	0	0	Set same value as SV48	
SV56	0	0	Set same value as rapid traverse time constant	

2)-2: When vertical axis is 2-axis driver

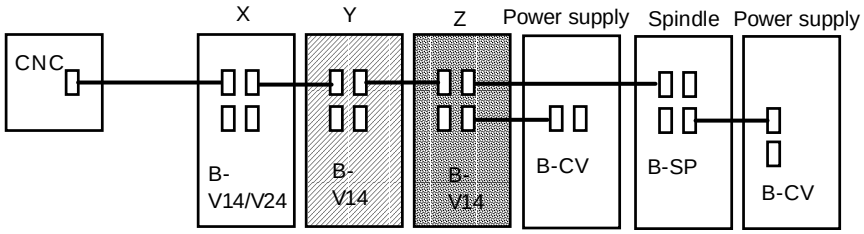


Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V24)	Z axis (B-V24)	Spindle (B-SP)
		2-axis servo driver	**Vertical axis 2-axis servo driver**	**Separate power supply connection (only spindle)**
SV48	0	Set same value as Z axis	Set with adjustments	Does not relay on software.
SV55	0	Set same value as Z axis	Set same value as SV48	
SV56	0	Set same value as rapid traverse time constant	Set same value as rapid traverse time constant	

***** When vertical axis is 2-axis driver, set for both L and M axes.

3) When power supply control axis is different driver than vertical axis servo axis (Example: When vertical axis is Y axis, and axis connected to power supply is Z axis)

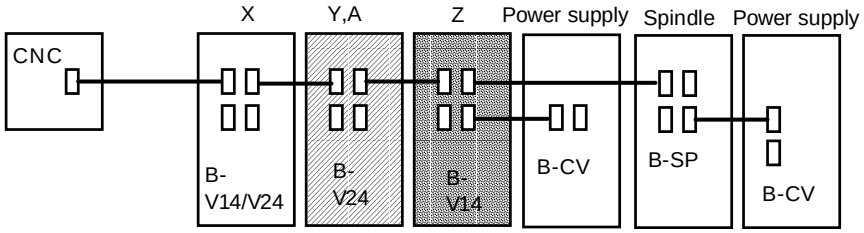
3)-1: When vertical axis and power supply axis are 1-axis driver



Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V14)	Z axis (B-V14)	Spindle (B-SP)
		Vertical axis	Axis connected to power supply	Separate power supply connection (only spindle)
SV48	0	Set with adjustments	Set same value as Y axis	Does not relay on software.
SV55	0	Set same value as SV48	Set same value as Y axis	
SV56	0	Set same value as rapid traverse time constant	Set same value as rapid traverse time constant	

***** When the vertical axis and power supply axis differ, the servo parameters must be set for both axes.

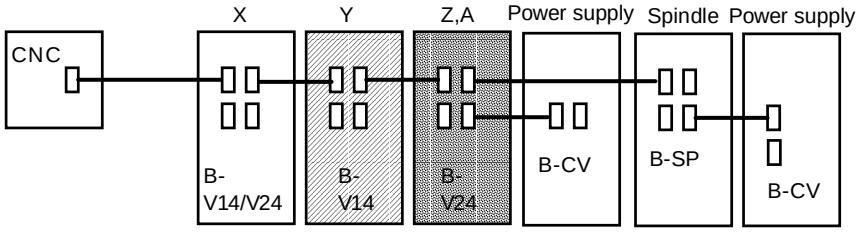
3)-2: When vertical axis and power supply axis are 2-axis driver



Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V24)	Z axis (B-V24)	A axis (B-V14)	Spindle (B-SP)
		Vertical axis 2-axis servo driver		Axis connected to power supply	Separate power supply connection (only spindle)
SV48	0	Set with adjustments	Set same value as Y axis	Set same value as Y axis	Does not relay on software.
SV55	0	Set same value as SV48	Set same value as Y axis	Set same value as Y axis	
SV56	0	Set same value as rapid traverse time constant	Set same value as rapid traverse time constant	Set same value as rapid traverse time constant	

***** When vertical axis is 2-axis driver, set for both L and M axes.

3)-3: When amplifier connected to the power supply is a 2-axis driver



Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V14)	Z axis (B-V24)	A axis (B-V24)	Spindle (B-SP)
		Vertical axis	Power supply connected driver 2-axis servo driver		Separate power supply connection (only spindle)
SV48	0	Set with adjustments	Set same value as Y axis	Set same value as Y axis	Does not relay on software.
SV55	0	Set same value as SV48	Set same value as Y axis	Set same value as Y axis	
SV56	0	Set same value as rapid traverse time constant	Set same value as rapid traverse time constant	Set same value as rapid traverse time constant	

***** If the driver connected to the power supply is a 2-axis driver, set both the L and M axes.

10-4-2 Deceleration control

Basically, this MDS-B-V14L servo driver carries out dynamic brake stopping when an emergency stop occurs. However, if the deceleration stop function is validated, the motor will decelerate according to the set time constant while maintaining the READY ON state. READY will turn OFF after the motor stops, and the dynamic brakes will be activated.

<Features>

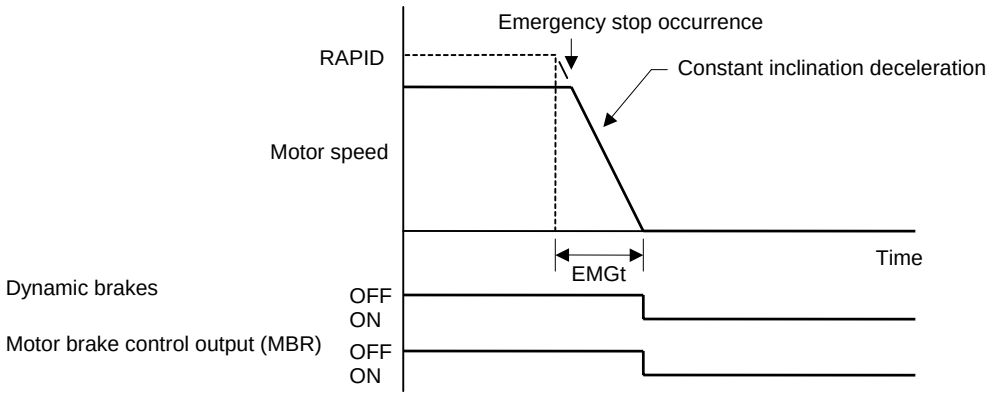
1. When the movable mass is large, deceleration and stop are possible in a short using the dynamic brakes. (Stopping is possible with a basically normal acceleration/deceleration time constant.)

(1) Setting the deceleration control time constant

The time to stopping from the rapid traverse rate (rapid: axis specification parameter) is set in the deceleration control time constant (SV056: EMGt). A position loop step stop is carried out when 0 is set.
When linear (straight line) acceleration/deceleration is selected for the rapid traverse, the same value as the acceleration/deceleration time constant (G0tL) becomes the standard value. When another acceleration/deceleration pattern is selected, set the rapid traverse to linear acceleration/deceleration. Adjust to the optimum acceleration/deceleration time constant, and set that value as the standard value.

<Operation>

When an emergency stop occurs, the motor will decelerate at the same inclination from each speed.



No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV055	EMGx	Max. delay time for emergency stop	Ms	Normally, the same value as SV056 EMGt is set. Set 0 when not using the deceleration stop function or drop prevention function.	0 to 5000 (ms)
SV056	EMGt	Deceleration control time constant	Ms	Set the time to stop from rapid traverse rate (rapid). Set the same value as the rapid traverse acceleration/ deceleration time constant (G0tL) as a standard. Set 0 when not using the deceleration stop function.	0 to 5000 (ms)

POINT

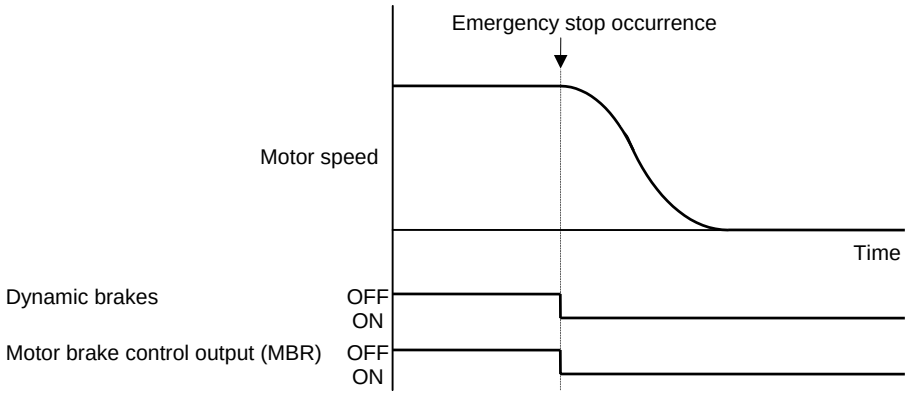
1. The deceleration will not be controlled when a servo alarm that uses the dynamic brake stopping method occurs. Stopping is by the dynamic brake method regardless of the parameter setting.
2. When a power failure occurs, the stopping method may change over to a dynamic brake stop during deceleration control if the deceleration time constant is set comparatively long. This is because of low bus voltage in the driver.

⚠ CAUTION

If the deceleration control time constant (EMGt) is set longer than the acceleration/deceleration time constant, the overtravel point (stroke end point) may be exceeded.
A collision may be caused on the machine end, so be careful.

(2) Dynamic brake stop

When the deceleration stop function is not used, the dynamic brakes will be used to stop.
In a dynamic brake stop, the dynamic brakes operate at the same time the emergency stop occurs, and the motor brake control output also operates at the same time.



10-5 Collision detection

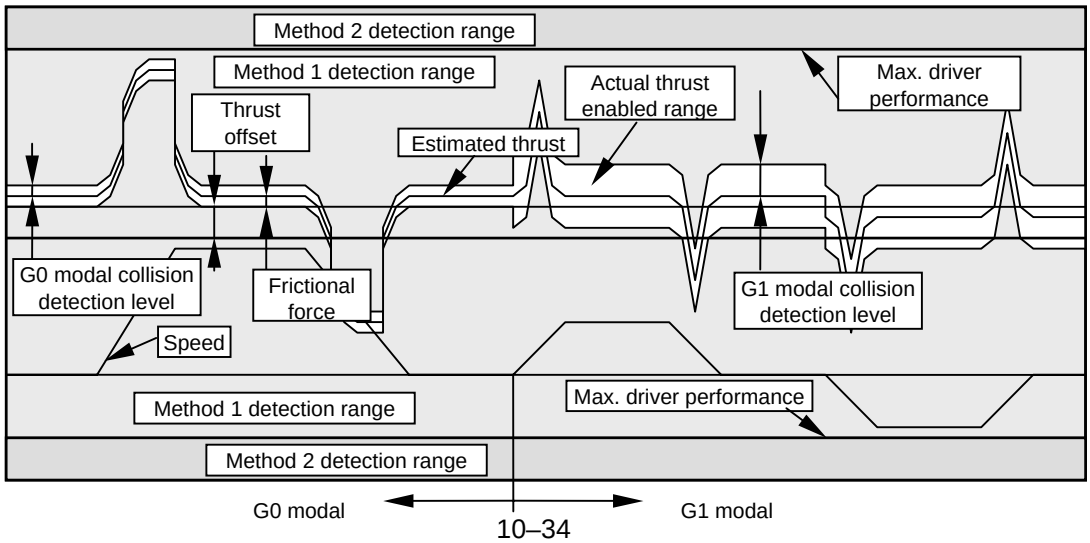
The purpose of the collision detection function is to quickly detect a collision and decelerate to a stop. This suppresses the abnormal torque generated to the machine tool, and suppresses the occurrence of an abnormality.
Impact during a collision cannot be prevented even when the collision detection function is used, so this function does not guarantee that the machine will not break and does not guarantee the machine accuracy after a collision. Thus, the conventional caution is required to prevent machine collisions from occurring.
Collisions are detected with the following two methods. With either method, a servo alarm will occur after decelerating to a stop.

(1) Method 1

The required thrust is calculated from the position command issued from the CNC. The disturbance thrust is calculated from the difference with the actual thrust. When this disturbance thrust exceeds the collision detection level set with the parameters, the axis will decelerate to a stop with the driver's max. thrust. After stopping, an alarm will occur and the system will stop.
Method 1 can be used only when using SHG control. (If not using SHG control, the load error alarm (58/59) will occur immediately during the acceleration/deceleration.)
With method 1, the collision detection level can be set independently for the rapid traverse and cutting feed. The collision detection level during cutting feed is set 0 to 7 times (integer-fold) using the rapid traverse collision detection level as a reference. When 0-fold is set, the collision detection method 1 will not function during cutting feed.

(2) Method 2

The axis will stop with the driver's max. thrust when the current command exceeds the driver's max. performance. After stopping, an alarm will occur and the system will stop.
Note that this can be ignored by setting the servo parameter SV035: SSF4/cl2n to 1.



<Setting and adjustment methods>

1. Confirm that SHG control is being used.
2. SV032: TOF Thrust offset
   Move the axis to be adjusted approx. F1000mm/mi with jog, etc., and check the load current on the [I/F DIAGNOSIS screen, Servo Monitor]. If the current load during movement is positive, check the max. value. If negative, check the min. value. Set the average value of the + and - directions.
3. SV045: TRUB Frictional force
   Move the axis to be adjusted approx. F1000mm/min both directions with jog, etc., and check the load current on the [I/F DIAGNOSIS screen, Servo Monitor]. Subtract the current load value for – direction movement from the current load value for + direction movement, and divide the result by 2. Set the absolute position of that value.
4. SV059: TCNV Estimated thrust gain
   Set SV035: SSF4/clt(bitF) of the axis to be adjusted to 1.
   Move the axis to be adjusted in both directions at the max. feedrate with jog, etc., until the MPOF display on the [I/F DIAGNOSIS screen, Servo Monitor] stabilizes.
   Set the MPOF value displayed on the [I/F DIAGNOSIS screen, Servo Monitor] screen.
   Return SV035: SSF4/clt (bitF) to 0.
5. SV035: SSF4/cl2n (bitB)
   If the acceleration/deceleration time constant is small and the current is limited, set 1.
6. SV060: TLMT Collision detection level (For method 1, G0 modal)
   First, set 100. (If SV035: SSF4/clet is set to 1, the MPOF value will indicate the past 2-sec. estimated disturbance thrust peak value, so this can be referred to for setting. Note that this displayed value is averaged, so first set a value that is approx. double the displayed value.)
   Carry out no-load operation at the max. rapid traverse speed. If an alarm occurs, increment the setting unit by 20.
   If an alarm does not occur, decrement the setting value by 10.
   Set a value that is approx. 1.5-times the limit value where an alarm does not occur.
7. SV035: SSF4/clG1 (bit12-14)
   Divide the max. cutting load by the SV060:TLMT setting value. (Round up the fraction). Set this value.

(Example) When max. cutting load is 200% and SV060:TLMT setting value is 80%
200/80 = 2.5→ The setting value is 3, so set 3xxx in SV035:SSF4.

No.	Abbrev.	Parameter name	Explanation
SV035	SSF4	Special servo function selection 4	The collision detection is set with the following parameters.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
clt	clG1			cl2n	clet	cltq			iup	tdt					

bit		Meaning when "0" is set.	Meaning when "1" is set.
8,9	cltq	Set the deceleration torque for collision detection.	
10	clet	Setting for normal use	The past 2-sec. estimated disturbance thrust peak value is displayed at MPOF on the Servo Monitor screen.
11	cl2n	Setting for normal use	Collision detection method 2 is invalidated.
12 to 14	clG1	Set the collision detection level for the collision detection method 1, G1 modal. When 0 is set: The method 1, G1 modal collision detection will not be carried out. When 1 to 7 is set: The method 1, G0 modal collision detection level will be set to a value obtained by multiplying (SV060: TLMT) by the set value.	
15	clt	Setting for normal use	The guide value for the SV059: TCNV setting value is displayed at MPOF on the Servo Monitor screen.

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV032	TOF	Thrust offset	Stall % (rated current %)	Set the unbalance thrust amount of an axis having an unbalanced thrust, such as a vertical axis, as a percentage (%) in respect to the stall rated current.	–100 to 100
SV045	TRUB	Current compensation/ frictional force	Stall % (rated current %)	When using the collision detection function, set the frictional force as a percentage in respect to the stall rated current. The low-order 8 bits are used. Set 0 when not using the collision detection function.	0 to 100
SV059	TCNV	Estimated thrust gain		When using the collision detection function, set the estimated thrust gain. When SV035:SSFS4/clt is set to 1, the setting value guide will display at MPOF on the Servo Monitor screen. Set 0 when not using the collision detection function.	0 to 32767
SV060	TLMT	G0 collision detection level	Stall % (rated current %)	When using the collision detection function, set the collision detection level for the method G0 modal as a percentage in respect to the stall rated current. Set 0 when not using the collision detection function.	0 to 100

POINT

1. Even when validated, this function does not guarantee that the machine will not break and does not guarantee the machine accuracy after a collision. Thus, the conventional caution must be taken during machine operation to prevent accidents.
2. If the collision detection limit is set at the extreme limit, an incorrect detection may be made even in the normal state. Thus, set the collision detection level to a slightly larger value.
3. After adjusting the machine or replacing the motor or detector replaced during maintenance, adjust the collision detection related parameters again.
4. If the detector resolution has been changed due to replacement of the detector, or when the position control system has been changed (changed between the closed loop or semi-closed loop, etc.), the SV059: TCNV estimated thrust gain must be changed.

10-6 Parameter list

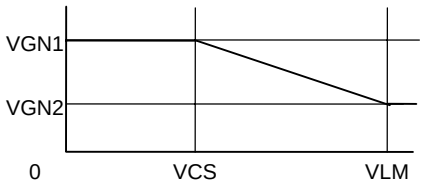
There are 64 servo parameters. The methods for setting and displaying the servo parameters differ on the CNC being used, so refer to the instruction manual for the respective CNC.

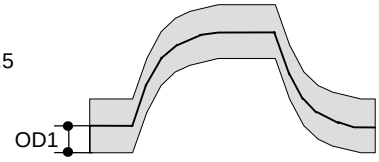
Name	Abbrev.	Descriptions	Setting screen	B-Vx compa-tibility	Chang-ing method	Setting unit	Min. unit	Max. unit	Class		
									Machine specifica-tions	Servo specifica-tions	Adjust-ment
SV001	PC1	Motor side gear ratio	Specifi-cations	○	Default		1	32767	○		
SV002	PC2	Machine side gear ratio	Specifi-cations	○	Default		1	32767	○		
SV003	PGN1	Position loop gain 1	Specifi-cations	○	Normal	rad/s	1	200			○
SV004	PGN2	Position loop gain 2	Adjust-ment	○	Normal	rad/s	0	999		○	
SV005	VGN1	Speed loop gain 1	Adjust-ment	○	Normal		1	999			○
SV006	VGN2	Speed loop gain 2		○	Normal		–1000	1000			○
SV007	VIL	Speed loop delay compensation	Adjust-ment	○	Normal		0	32767			○
SV008	VIA	Speed loop leading compensation	Adjust-ment	○	Normal		1	9999			○
SV009	IQA	Current loop q axis compensation		○	Normal		1	20480		○	
SV010	IDA	Current loop d axis compensation		○	Normal		1	20480		○	
SV011	IQG	Current loop q axis gain		○	Normal		1	4096		○	
SV012	IDG	Current loop d axis gain		○	Normal		1	4096		○	
SV013	ILMT	Current limit value		○	Normal	Stall current %	0	999			○
SV014	ILMTsp	Current limit value during special operation		○	Normal	Stall current %	0	999			○
SV015	FFC	Acceleration feed forward gain	Adjust-ment	○	Normal	%	0	999		○	
SV016	LMC1	Lost motion compensation 1	Adjust-ment	○	Normal	Stall current %	–1	200			○
SV017	SPEC	Servo specifications	Specifi-cations	Δ	Default	HEX setting	*	*	○	○	○
SV018	PIT	Linear motor pole pitch	Specifi-cations	○	Default	mm	1	32767	○		
SV019	RNG1	Position detector resolution	Specifi-cations	○	Default	kp/PIT	1	9999		○	
SV020	RNG2	Speed detector resolution	Specifi-cations	○	Default	kp/PIT	1	9999		○	
SV021	OLT	Overload time constant		○	Normal	s	1	300		○	
SV022	OLL	Overload detection level		○	Normal	Stall current %	1	500		○	
SV023	OD1	Excessive error detection width during servo ON		○	Normal	mm	0	32767	○		
SV024	INP	In-position detection width		○	Normal	µm	0	32767	○		
SV025	MTYP	Motor/detector type	Specifi-cations	Δ	Default	HEX setting	*	*		○	
SV026	OD2	Excessive error detection width during servo OFF		○	Normal	mm	0	32767	○		
SV027	SSF1	Special servo function selection 1	Specifi-cations	Δ	Normal	HEX setting	*	*		○	○
SV028	MSFT	Linear motor pole shift amount		□	Default	µm	–30000	30000			○
SV029	VCS	Speed loop gain, change start speed		○	Normal	mm/s	0	9999			○
SV030	IVC	Current/voltage compensation		○	Normal		–32768	32767			○
SV031	OVS1	Overshooting compensation	Adjust-ment	○	Normal	%	–1	100			○
SV032	TOF	Thrust offset	Adjust-ment	○	Normal	Stall current %	–100	100			○
SV033	SSF2	Special servo function selection 2	Specifi-cations	Δ	Normal	HEX setting	*	*		○	○
SV034	SSF3	Special servo function selection 3		○	Normal	HEX setting	*	*		○	○
SV035	SSF4	Special servo function selection 4		○	Normal	HEX setting	*	*		○	○
SV036	PTYP	Power supply type	Specifi-cations	○	Default	HEX setting	*	*		○	
SV037	JL	Total movable mass during linear motor	Adjust-ment	○	Normal	kg	0	5000			○
SV038	FHz1	Machine resonance suppression filter center frequency 1	Adjust-ment	Δ	Normal	Hz	0	9000	○		
SV039	LMCD	Lost motion compensation timing		○	Normal	ms	0	2000			○
SV040	LMCT	Current compensation/lost motion compensation non-sensitive band	Adjust-ment	○	Normal	–/µm	–32768	32767			○
SV041	LMC2	Lost motion compensation 2	Adjust-ment	○	Normal	Stall current %	–1	200			○
SV042	OVS2	Overshooting compensation 2		○	Normal	Stall current %	–1	100			○
SV043	OBS1	Observer 1		○	Normal	rad	0	1000			○
SV044	OBS2	Observer 2		○	Normal	%	0	500			○
SV045	TRUB	Current compensation/frictional force		○	Normal	–/Stall current %	–32768	32767			○
SV046	FHz2	Machine resonance suppression filter center frequency 2	Adjust-ment	□	Normal	Hz	0	9000			
SV047	EC1	Inductive voltage compensation		○	Normal	%	*	*			○
SV048	EMGrt	Brake operation delay time		○	Normal	ms	0	2000	○		
SV049	PGN1sp	Position loop gain 1 during special operation		○	Normal	rad/s	1	200			○
SV050	PGN2sp	Position loop gain 2 during special operation		○	Normal	rad/s	0	999		○	
SV051	DFBT			○	Normal	ms	0	9999			○
SV052	DFBN			○	Normal	µm	0	9999			○
SV053	OD3	Excessive error detection width during special operation		○	Normal	mm	0	32767	○		
SV054	ORE	CN3 connection system, overrun detection width		○	Normal	mm	–1	32767	○		

Name	Abbrev.	Descriptions	Setting screen	B-Vx compa-t ibility	Chang-i ng method	Setting unit	Min. unit	Max. unit	Class		
SV055	EMGx	Emergency stop max. delay time		○	Normal	ms	0	2000	○		
SV056	EMGt	Deceleration time constant during emergency stop		○	Normal	ms	0	2000	○		
SV057	SHGC	SHG control gain		○	Normal	rad/s	0	1200		○	
SV058	SHGCsp	SHG control gain during special operation		○	Normal	rad/s	0	1200		○	
SV059	TCNV	Estimated thrust gain		○	Normal		0	32767			○
SV060	TLMT	G0 collision detection level		○	Normal	Stall current %	0	500			○
SV061	DA1NO	D/A output channel 1 data No./ DC excitation default excitation level		Δ	Normal		*	*			○
SV062	DA2NO	D/A output channel 2 data No./ DC excitation final excitation level		Δ	Normal		*	*			○
SV063	DA1MPY	D/A output channel 1 output scale/ DC excitation default excitation time		Δ	Normal	/ms	*	*			○
SV064	DA2MPY	D/A output channel 2 output scale		○	Normal		*	*			

Setting screen	Specifications: Set on the Servo Specifications screen.	Adjustment: Set on the Servo Adjustment screen
B-Vx compatibility	○ : No changes from MDS-B-Vx. ▲ : The same settings as MDS-B-Vx can be used, but the details will be changed.	Δ : The latest parameters with MDS-B-Vx4 are included. □ : New parameters with MDS-B-Vx4.
Changing method	Default: The setting value is validated when the CNC power is turned ON.	Constant: The setting value is validated when changed.

Details of parameters

No.	Abbrev.	Details	Setting range (Unit)
SV001	PC1	Set 1 for the linear motor system.	1 to 32767
SV002	PC2	Set 1 for the linear motor system.	1 to 32767
SV003	PGN1	Set the position loop gain in increments of 1. Normally, 47 is set.	1 to 200 (rad/s)
SV004	PGN2	When carrying out SHG control, set together with SV057: SHGC. Normally, 0 is set when not using 125.	0 to 999 (rad/s)
SV005	VGN1	Set the speed loop gain. 150 is set as a standard. If increased, the response will increase but the vibration and noise will increase.	1 to 999
SV006	VGN2	If the noise is bothersome at high speeds, such as during rapid traverse, set the speed loop gain (smaller than VGN1) for high speeds (1.2-times the rated speed). The speed to start dropping the speed gain is set with SV029:VCS. Set 0 when not using this function. 	–1000 to 1000
SV007	VIL	Set this when a limit cycle occurs, of if overshooting occurs during positioning. Set 0 when not using this function. Related parameters: SV027:SSF1/vcnt1, vcnt2	0 to 32767
SV008	VIA	Set the speed loop advance compensation.	1 to 9999 (0.0687rad/s)
SV009	IQA	Set the current loop internal compensation. The setting value is fixed according to the motor being used. (Refer to section 9-2-4 List of standard parameters for each motor.)	1 to 20480
SV010	IDA	Set the current loop internal compensation. The setting value is fixed according to the motor being used. (Refer to section 9-2-4 List of standard parameters for each motor.)	1 to 20480
SV011	IGQ	Set the current loop internal compensation. The setting value is fixed according to the motor being used. (Refer to section 9-2-4 List of standard parameters for each motor.)	1 to 4096
SV012	IDG	Set the current loop internal compensation. The setting value is fixed according to the motor being used. (Refer to section 9-2-4 List of standard parameters for each motor.)	1 to 4096
SV013	ILMT	Set the current limit value as a percentage (%) in respect to the stall rated current. To use to the driver's max. thrust, set 800. (Limit value in both + and – directions.)	0 to 999 (Stall rated current %)
SV014	ILMTsp	Set the current limit value for special operations (absolute position default setting, stopper operation, etc.) as a percentage (%) in respect to the stall rated current. To use to the driver's max. thrust, set 800. (Limit value in both + and – directions.)	0 to 999 (Stall rated current %)
SV015	FFC	Set this when the overshooting amount during feed forward control, or the relative error during synchronous control, etc., is large. Set to 0 when not using this function.	0 to 999 (%)
SV016	LMC1	Set this parameter if the protrusion (caused by non-sensitive band from friction, torsion, backlash, etc.) is large when the arc quadrant is changed. This is valid only when lost motion compensation (SV027: lmc1, lmc2) are selected.	–1 to 200
		Type 1 SV027:SSF1/lmc1=1/lmc2=0 Protrusions during low-speed interpolation can be eliminated with this type of compensation. The compensation gain will be 0 when 0 is set. 100% compensation will be carried out when 100 is set.	0 to 200 (%)
		Type 2 SV027:SSF1/lmc1=0/lmc2=1 This type is the standard for the MDS Series. Use this type during high-speed high-accuracy interpolation if sufficient compensation is not possible with type 1. Set as a percentage (%) in respect to the stall rated current.	0 to 100 (Stall rated current %)
		To change the compensation gain (type 1) or compensation amount (type 2) according to the direction. To set a different value according to the command direction, set this in addition to SV041: LMC2. Set the value for changing the command speed from the – to + direction (during command direction CW) in SV016:LMC1. Set the value for changing the command speed from the + to – direction (during command direction CW) in SV041:LMC2. When –1 is set, compensation will not be carried out when the command speed direction changes.	

<table>
<tr><th>Name</th><th>Abbrev.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV017</td><td>SPEC</td><td>Servo specifications
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">spm</td><td>drvall</td><td>drvup</td><td>mpt3</td><td>mp</td><td>abs</td><td>vmh</td><td>vdir</td><td>fdir</td><td></td><td>seqh</td><td>dfbx</td><td>vdir2</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0</td><td>vdir2</td><td>Sub side (CN3 connector) feedback forward polarity</td><td>Sub side (CN3 connector) feedback reverse polarity</td></tr>
<tr><td>1</td><td>dfbx</td><td colspan="2">Not used for linear motor.
Set to "0".</td></tr>
<tr><td>2</td><td>seqh</td><td>READY/servo ON time, normal mode</td><td>READY/servo ON time, time reduction mode</td></tr>
<tr><td>3</td><td></td><td colspan="2">Set to "0".</td></tr>
<tr><td>4</td><td>fdir</td><td>Main side (CN2 connector) feedback forward polarity</td><td>Main side (CN2 connector) feedback reverse polarity</td></tr>
<tr><td>5</td><td>vdir</td><td colspan="2">Set to "0".</td></tr>
<tr><td>6</td><td>vmh</td><td>Normal processing mode</td><td>High-speed processing mode
∗ For the linear system, set the high-speed processing mode.</td></tr>
<tr><td>7</td><td>abs</td><td>Incremental position detection</td><td>Absolute position detection</td></tr>
<tr><td>8</td><td>mp</td><td colspan="2" rowspan="2">Not used for linear motor.
Set to "0".</td></tr>
<tr><td>9</td><td>mpt3</td></tr>
<tr><td>A</td><td>drvup</td><td>Combination with standard motor driver</td><td>Set when using a combination with a driver having a capacity one rank above or below the standard motor drive.</td></tr>
<tr><td>B</td><td>drvall</td><td>Normal setting</td><td>Set when using a combination of driver having a capacity different from the standard motor driver.</td></tr>
<tr><td>C</td><td rowspan="4">spm</td><td colspan="2" rowspan="4">Special motor selection
Standard linear motor: 6
Special linear motor : 7
Refer to 9-2-1 (5) List of motor types.</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table></td><td>HEX setting</td></tr>
<tr><td>SV018</td><td>PIT</td><td>Set the pole pitch.</td><td>1 to 32767 (mm)</td></tr>
<tr><td>SV019</td><td>RNG1</td><td>Set the resolution per pole pitch of the detector used for position control.</td><td>1 to 9999 (kp/PIT)</td></tr>
<tr><td>SV020</td><td>RNG2</td><td>Set the resolution per pole pitch of the detector used for speed control.</td><td>1 to 9999 (kp/PIT)</td></tr>
<tr><td>SV021</td><td>OLT</td><td>Set the detection time constant for overload 1 (OL1).
Normally, set 60.</td><td>1 to 300 (s)</td></tr>
<tr><td>SV022</td><td>OLL</td><td>Set the current detection level of overload 1 (OL1) as a percentage (%) in respect to the stall rated current.
Normally, set 150.</td><td>1 to 500 (Stall rated current %)</td></tr>
<tr><td>SV023</td><td>OD1</td><td>Set the excessive error detection width for servo ON.
Setting method
SV023:OD1 = SV026:OD2 = SV053:OD3 =
$F / (60 \times PGN1) \times 0.5$
F : Max. rapid traverse speed (mm/min)
PGN1: Position loop gain 1 (rad/s)
When 0 is set, the excessive error will not be detected at servo ON.
 
</td><td>0 to 32767 (mm)</td></tr>
<tr><td>SV024</td><td>INP</td><td>Set the in-position detection width.
Normally, set 50.</td><td>0 to 32767 (μm)</td></tr>
</table>

<table>
<tr><th>Name</th><th>Abbrev.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV025</td><td>MTYP</td><td>Motor/detector type
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">pen</td><td colspan="4">ent</td><td colspan="8">mtyp</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0</td><td rowspan="8">mtyp</td><td rowspan="8">Set the motor type.
(Refer to 7-201 (6) List of motor types.)</td><td rowspan="8"></td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td rowspan="4">ent</td><td rowspan="4">Set the speed detector type.
(Refer to 9-2-1 (6) List of detector types.)</td><td rowspan="4"></td></tr>
<tr><td>9</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="4">Pen</td><td rowspan="4">Set the position detector type.
(Refer to 9-2-1 (6) List of detector types.)</td><td rowspan="4"></td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table></td><td>HEX setting</td></tr>
<tr><td>SV026</td><td>OD2</td><td>Set the excessive error detection width for servo OFF. Normally, the same value as SV023:OD1 is set.
When 0 is set, the excessive error will not be detected at servo OFF.</td><td>0 to 32767 (mm)</td></tr>
<tr><td>SV027</td><td>SSF1</td><td>Special servo function selection 1
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td>afrg</td><td>afse</td><td>ovs2</td><td>ovs1</td><td>lmc2</td><td>lmc1</td><td>omr</td><td></td><td>vfct2</td><td>vfct1</td><td></td><td>upc</td><td>vcnt2</td><td>vcnt1</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0</td><td>vcnt1</td><td rowspan="2">00: Delay compensation changeover invalid
01: Delay compensation changeover type 1</td><td rowspan="2">10: Delay compensation changeover type 2
11: Spare</td></tr>
<tr><td>1</td><td>vcnt2</td></tr>
<tr><td>2</td><td>upc</td><td>Start torque compensation invalid</td><td>Start torque compensation valid</td></tr>
<tr><td>3</td><td></td><td colspan="2">Set to "0".</td></tr>
<tr><td>4</td><td>vfct1</td><td rowspan="2">00: Jitter compensation invalid
01: Jitter compensation 1 pulse</td><td rowspan="2">10: Jitter compensation 2 pulse
11: Jitter compensation 3 pulse</td></tr>
<tr><td>5</td><td>vfct2</td></tr>
<tr><td>6</td><td></td><td colspan="2">Set to "0".</td></tr>
<tr><td>7</td><td>omr</td><td>OMR control invalid</td><td>OMR control valid</td></tr>
<tr><td>8</td><td>lmc1</td><td rowspan="2">00: Lost motion compensation valid
01: Lost motion compensation type 1</td><td rowspan="2">10: Lost motion compensation type 2
11: Spare</td></tr>
<tr><td>9</td><td>lmc2</td></tr>
<tr><td>A</td><td>ovs1</td><td rowspan="2">00: Overshoot compensation invalid
01: Overshoot compensation type 1</td><td rowspan="2">10: Overshoot compensation type 2
11: Overshoot compensation type 3</td></tr>
<tr><td>B</td><td>ovs2</td></tr>
<tr><td>C</td><td>afse</td><td>Setting for normal use</td><td>Adaptive filter sensitivity increase
*Note 1</td></tr>
<tr><td>D</td><td>afrg</td><td>Setting for normal use</td><td>Set this when the adaptive filter is effective in the speed band.</td></tr>
<tr><td>E</td><td>zrn2</td><td>Reference point return type 1</td><td>Reference point return type 2</td></tr>
<tr><td>F</td><td>aflt</td><td>Adaptive filter invalid</td><td>Adaptive filter valid</td></tr>
</table></td><td>HEX setting

* Note 1
When afse (bitC) is set to "1", also set afrg (bitD) to "1".</td></tr>
<tr><td>SV028</td><td>MSFT</td><td>Set the pole shift amount.</td><td>–30000 to 30000 (µm)</td></tr>
<tr><td>SV029</td><td>VCS</td><td>If the noise is bothersome during high-speeds, such as during rapid traverse, set the speed loop gain's drop start motor speed.
The speed loop gain drop target speed loop gain is set in SV006: VGN2.
Set to 0 when not using this function.</td><td>0 to 9999 (mm/s)</td></tr>
<tr><td>SV030</td><td>IVC</td><td>• Voltage non-sensitive band compensation: The low-order 8 digits are used.
• Current bias: The high-order 8 digits are used. (Icx)
This is used in combination with the SV040 and SV045 high-order 8 digits.</td><td>–32768 to 32767</td></tr>
<tr><td>SV031</td><td>OVS1</td><td>Set this if overshooting occurs during deceleration stop with control using the submicron control or system using CN3. The overshooting will be improved as the value is increased.
Normally, set this as approx. 2 to 10 (%) (percentage in respect to stall rated current).
(Increment the value in 2% increments and find the value where overshooting does not occur.)
This is valid only when overshoot compensation (SV027: SSF1/ovs1, ovs2) is selected.</td><td>–1 to 100 (Stall rated current %)</td></tr>
</table>

<table>
<tr><th>Name</th><th>Abbrev.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV032</td><td>TOF</td><td>Set the unbalance thrust amount of an axis having an unbalanced thrust, such as a vertical axis, as a percentage in respect to the stall rated current.
This is used when SV027: SSF1/lmc1, lmc2 or SV027: SSF1/vcnt1, vcnt2 is set.</td><td>–100 to 100</td></tr>
<tr><td>SV033</td><td>SSF2</td><td>Special servo function selection 2
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">dos</td><td colspan="4">dis</td><td colspan="4">nfd2</td><td>nf3</td><td colspan="3">nfd1</td><td>zck</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0</td><td>zck</td><td>Z phase check valid (part of alarm 42)</td><td>Z phase check invalid</td></tr>
<tr><td>1
2
3</td><td>nfd1</td><td colspan="2">Adjust the damping mount of the 1st machine resonance suppression filter.
The effect of the machine resonance suppression filter will drop as the setting value is increased, and the effect on the speed control will drop.
000: –∞ 010: –12dB 100: –6dB 110: –3dB
001: –18dB 011: –9dB 101: –4dB 111: –1dB</td></tr>
<tr><td>4</td><td>nf3</td><td colspan="2">Validate the 3rd machine resonance suppression filter. (Center frequency fixed to 1125Hz)</td></tr>
<tr><td>5
6
7</td><td>nfd2</td><td colspan="2">Adjust the damping mount of the 2nd machine resonance suppression filter.
The effect of the machine resonance suppression filter will drop as the setting value is increased, and the effect on the speed control will drop.
000: –∞ 010: –12dB 100: –6dB 110: –3dB
001: –18dB 011: –9dB 101: –4dB 111: –1dB</td></tr>
<tr><td>8
9
A
B</td><td>dis</td><td colspan="2">Digital signal input selection
Set this to 0000.</td></tr>
<tr><td>C
D
E
F</td><td>dos</td><td colspan="2">Digital signal output selection
0000: For normal use
0001: Specified speed signal output</td></tr>
</table></td><td>HEX setting</td></tr>
<tr><td>SV034</td><td>SSF3</td><td>Special servo function selection 3
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">ovsn</td><td colspan="4">linN</td><td>toff</td><td>os2</td><td></td><td>dcd</td><td>test</td><td>mohn</td><td>has2</td><td>(has1)</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0</td><td>has1</td><td>Setting for normal use</td><td>(HAS control 1 valid, high-speed compatible)</td></tr>
<tr><td>1</td><td>has2</td><td>Setting for normal use</td><td>HAS control 2 valid, overshooting compatible</td></tr>
<tr><td>2</td><td>mohn</td><td>Setting for normal use</td><td>Ignore MDS-B-HR motor thermal error</td></tr>
<tr><td>3</td><td>test</td><td>Setting for normal use</td><td>Default test (Errors are sensitively detected)</td></tr>
<tr><td>4</td><td>dcd</td><td>Setting for normal use</td><td>DC excitation mode
Use this for setting up the linear motor.</td></tr>
<tr><td>5</td><td></td><td colspan="2">Set to "0".</td></tr>
<tr><td>6
7</td><td>os2
toff</td><td colspan="2">Not used for linear motor.
Set to "0".</td></tr>
<tr><td>8
9
A
B</td><td>linN</td><td colspan="2">Set the No. of axes connected in parallel when using the linear motor.
When 0 is set, the No. is interpreted as 1 axis.</td></tr>
<tr><td>C
D
E
F</td><td>ovsn</td><td colspan="2">Set the overshoot compensation type 3 non-sensitive band.</td></tr>
</table></td><td>HEX setting</td></tr>
</table>

<table>
<tr><th>Name</th><th>Abbrev.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV035</td><td>SSF4</td><td>
Special servo function selection 4
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>clt</td><td colspan="3">clG1</td><td>cl2n</td><td>clet</td><td colspan="2">cltq</td><td></td><td>iup</td><td colspan="6">tdt</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0
1
2
3
4
5</td><td>tdt</td><td colspan="2">Td creation time setting (driver-fixed)
Setting time (µs) = (tdt+1) × 0.569
Setting time when 0 is set
Less than 7kW: 5.69µsec, 7kW or more: 8.52µs
When tdt < 9, the setting is handled as tdt = 0.
Normally, set 0.</td></tr>
<tr><td>6</td><td>iup</td><td>Setting for normal use</td><td>Do not set (For special applications)</td></tr>
<tr><td>7</td><td></td><td colspan="2">Set to "0".</td></tr>
<tr><td>8
9</td><td>cltq</td><td colspan="2">Set the deceleration torque for collision detection.
00: 100% 01: 90% 10: 80% 11: 70%</td></tr>
<tr><td>A</td><td>clet</td><td>Setting for normal use</td><td>The past 2-sec. estimated disturbance thrust peak value is displayed at MPOF on the Servo Monitor screen.</td></tr>
<tr><td>B</td><td>cl2n</td><td>Setting for normal use</td><td>Collision detection method 2 is invalidated.</td></tr>
<tr><td>C
D
E</td><td>clG1</td><td colspan="2">Set the collision detection level for the collision detection method 1, G1 modal.
When 0 is set : The method 1, G1 modal collision detection will not be carried out.
When 1 to 7 is set : The method 1, G0 modal collision detection level will be set to a value obtained by multiplying (SV060: TLMT) by the set value.</td></tr>
<tr><td>F</td><td>clt</td><td>Setting for normal use</td><td>The guide value for the SV059: TCNV setting value is displayed at MPOF on the Servo Monitor screen.</td></tr>
</table>
</td><td>HEX setting</td></tr>
<tr><td>SV036</td><td>PTYP</td><td>
Power supply type
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">amp</td><td colspan="4">rtyp</td><td colspan="8">ptyp</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0
1
2
3
4
5
6
7</td><td>ptyp</td><td colspan="2">Set the power supply type.
(Refer to 9-2-1 (7) List of power supply types.)</td></tr>
<tr><td>8
9
A
B</td><td>rtyp</td><td colspan="2">Set 0 if the power supply unit is a power regeneration type.
If the power supply unit is a resistance regeneration type, set the type of resistor being used.
(Refer to 9-2-1 (7) List of power supply types.)</td></tr>
<tr><td>C
D
E
F</td><td>amp</td><td colspan="2">Set the driver's model No.
0:MDS-B-V14/V24,MDS-B-V1/V2/SP,MDS-A-V1 / V2 / SP
1:MDS-A-SVJ
2:MDS-A-SPJ</td></tr>
</table>
</td><td>HEX setting</td></tr>
<tr><td>SV037</td><td>JL</td><td>Set the total mass of the moving section (including the motor mass) with a kg unit.</td><td>0 to 5000 (kg)</td></tr>
<tr><td>SV038</td><td>FHz1</td><td>Set the center frequency of the 1st machine resonance suppression filter.
Set a value that is 36Hz or more.
Set 0 when not using this function.
When setting a low frequency that is 100Hz, also set SV033:SSF2/nfd1.</td><td>0 to 9000 (Hz)</td></tr>
<tr><td>SV039</td><td>LMCD</td><td>Set this when the lost motion compensation timing does not match.
Adjust while incrementing in 10(ms) units.</td><td>0 to 2000 (ms)</td></tr>
</table>

Name	Abbrev.	Details	Setting range (unit)
SV040	LMCT	• Set the lost motion compensation non-sensitive band. The low-order 8 digits are used. Set this when the lost motion compensation timing does not match during feed forward control. • Current bias: The high-order 8 digits are used. (Icy) This is used in combination with the SV030 and SV045 high-order 8 digits.	• Lost motion compensation non-sensitive band 0 to 100 (µm) ∗ Setting range: –32768 to 32767
SV041	LMC2	Normally set this to 0. Set this with SV016: LMC1 when setting the lost motion compensation's gain (type 1) or compensation amount (type 2) to different values according to the command direction. Set the value for changing the command speed from the – to + direction (during command direction CW) in SV016:LMC1. Set the value for changing the command speed from the + to – direction (during command direction CW) in SV041:LMC2. When –1 is set, compensation will not be carried out when the command speed direction changes. This is valid only when lost motion compensation (SV027: lmc1, lmc2) is selected.	–1 to 200 (%) (Stall rated current %)
SV042	OVS2	Overshoot compensation 2 Set the overshoot compensation amount for unidirectional movement (command direction CW). When 0 is set, the value set for SV031: OVS1 will be set. When –1 is set, compensation will not be carried out during unidirectional movement. This is valid only when lost motion compensation (SV027: lmc1, lmc2) is selected.	–1 to 200 (Stall rated current %)
SV043	OBS1	Observer 1 Set the observer pole. Normally, set this to approx. 628 (rad). SV037: JL and SV044: OBS2 must also be set to use the observer function. Set 0 when not using this function.	0 to 1000 (rad)
SV044	OBS2	Observer 2 Set the execution gain of the observer. Normally set 100. SV037: JL and SV043: OBS1 must also be set to use the observer function. Set 0 when not using this function.	0 to 500 (%)
SV045	TRUB	• Set the frictional force as a percentage in respect to the stall rated current when using the collision detection function. The low-order 8 bits are used. Set 0 when not using the collision detection function. • Current bias: The high-order 8 bits are used. (Ib1) This is used in combination with the SV030 and SV045 high-order 8 digits.	• Collision detection, friction 0 to 100 (Stall rated current %) ∗ Setting range: –32768 to 32767
SV046	FHz2	Set the center frequency of the 2nd machine resonance suppression filter. Set a value that is 36Hz or more. Set 0 when not using this function. When setting a low frequency that is 100Hz, also set SV033:SSF2/nfd2.	0 to 2250 (Hz)
SV047	EC1	Induction voltage compensation Set the execution gain for the induction voltage compensation. Normally, 100 is set.	–32768 to 32767 (%)
SV048	EMGrt	Set the brake operation delay time when using the drop prevention function. Set a value larger than the actual brake operation function. Set 0 when not using the drop prevention function. SV055: EMGx, SV056: EMGt must also be set when using this function.	0 to 9000 (ms)
SV049	PGN1sp	Set the position loop gain for special operations (synchronous tap, interpolation with spindle C axis, etc.). Norm ally, set the spindle position loop gain.	1 to 200 (rad/s)
SV050	PGN2sp	Set this with SV058:SHGCsp when carrying out SHG control during special operations (synchronous tap, interpolation with spindle C axis, etc.).	0 to 999 (rad/s)
SV051	DFBT	This is not used with the linear system. Set to 0.	0 to 9999 (ms)
SV052	DFBN	This is not used with the linear system. Set to 0.	0 to 9999 (µm)
SV053	OD3	Set the excessive error detection width at servo ON for special operations (absolute position default setting, stopper operation, etc.). When 0 is set, the excessive error will not be detected during special operations and servo ON.	0 to 32767 (mm)
SV054	ORE	Set the overrun detection width for the closed loop. When –1 is set, the overrun will not be detected. When 0 is set, the overrun will be detected with a 2(mm) width.	–1 to 32767 (mm)
SV055	EMGx	Set the max. delay time for emergency stop when using the drop prevention function. Normally, the same value as SV056: EMGt is set. Set 0 when not using the drop prevention function.	0 to 2000 (ms)

Name	Abbrev.	Details	Setting range (unit)
SV056	EMGt	Set the deceleration time constant from the max. rapid traverse speed when using the drop prevention function. Normally, the same value as the normal CNC G0 acceleration/deceleration time constant is set. Set 0 when not using the drop prevention function.	0 to 2000 (ms)
SV057	SHGC	Set this with SV004: PGN2 when carrying out SGH control. Normally, set this to 281. Set 0 when not using this function.	0 to 1200 (rad/s)
SV058	SHGCsp	Set this with SV050: PGN2sp when carrying out SHG control during special operations (synchronous tap, interpolation with spindle C axis, etc.). Set 0 when not using this function.	0 to 1200 (rad/s)
SV059	TCNV	Set the estimated thrust gain when using the collision detection function. If 1 is set for SV035: SSF4/clt, the guide for the setting value will display at MPOF on the Servo Monitor screen. Set 0 when not using the collision detection function.	0 to 32767
SV060	TLMT	Set the collision detection level for method 1 G0 modal as a percentage in respect to the stall rated current when using the collision detection function. Set 0 when not using the collision detection function.	0 to 100 (Stall rated current %)
SV061	DA1NO	Set the output data No. of the D/A output channel 1. When –1 is set, D/A output will not be carried out for that axis. Set the default excitation level for DC excitation. Set –250 when starting DC excitation.	–32768 to 32767
SV062	DA2NO	Set the output data No. of the D/A output channel 2. When –1 is set, D/A output will not be carried out for that axis. Set the default excitation level for DC excitation. Set –250 when starting DC excitation.	–32768 to 32767
SV063	DA1MPY	Set the output scale of the D/A output channel 1. The output scale is (setting value)/256. When 0 is set, it is interpreted as 256. (Output scale 1-fold) Set the default excitation time for DC excitation. (ms) Normally, 500 is set.	–32768 to 32767
SV064	DA2MPY	Set the output scale of the D/A output channel 2. The output scale is (setting value)/256. When 0 is set, it is interpreted as 256. (Output scale 1-fold)	–32768 to 32767

Chapter 11 Troubleshooting

11-1 Points of caution and confirmation

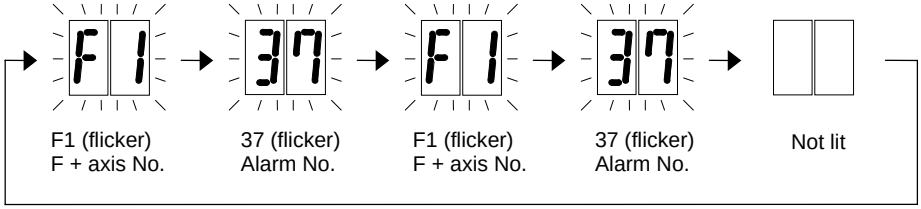
If an error occurs in the servo system, the servo warning or servo alarm will occur. When a servo warning or alarm occurs, check the state while observing the following points, and inspect or remedy the unit according to the details given in this section.

⚠ CAUTION

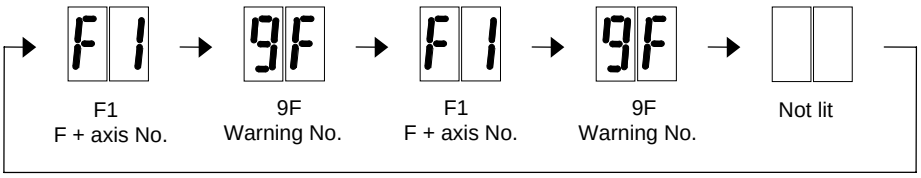
1. This servo system uses a large capacity electrolytic capacitor. When the CHARGE lamp on the front of the power supply unit (MDS-B-CV, MDS-A-CR) in the system is lit, there is a residual voltage. Take special care to prevent accidents such as electric shocks and short-circuits. (The voltage will remain for several minutes after the power is turned OFF.)
2. The conductivity in the driver cannot be checked due to the structure.
3. Do not carry out a mega test as the driver could be damaged.

<Points of confirmation>

1. What is the alarm code display?
2. Can the error or trouble be repeated? (Check alarm history)
3. Is the motor and servo driver temperature and ambient temperature normal?
4. Are the servo driver, control unit and motor grounded?
5. Was the unit accelerating, decelerating or running at a set speed? What was the speed?
6. Is there any difference during forward and backward run?
7. Was there a momentary power failure?
8. Did the trouble occur during a specific operation or command?
9. At what frequency does the trouble occur?
10. Is a load applied or removed?
11. Has the driver unit been replaced, parts replaced or emergency measures taken?
12. How many years has the unit been operating?
13. Is the power voltage normal? Does the state change greatly according to the time band?



LED display during servo alarm



LED display during servo warning

11-2 Troubleshooting at start up

If the CNC system does not start up correctly and a system error occurs when the CNC power is turned ON, the servo driver may not have been started up correctly.
Confirm the LED display on the driver, and take measures according to this section.

LED display	Symptom	Cause of occurrence	Investigation method	Remedy
AA	Initial communication with the CNC was not completed correctly.	The amplifier axis No. setting is incorrect.	Is there any other driver that has the same axis No. set?	Set correctly.
		The CNC setting is incorrect.	Is the No. of CNC controlled axes correct?	Set correctly.
		Communication with CNC is incorrect.	Is the connector (CN1A, CN1B) disconnected?	Connect correctly.
			Is the cable broken? Check the conductivity with a tester.	Replace the cable.
Ab	Initial communication with the CNC was not carried out.	The axis is not used, the setting is for use inhibiting.	Is the axis setting rotary switch set to "7" to "F"?	Set correctly.
		Communication with CNC is incorrect.	Is the connector (CN1A, CN1B) disconnected?	Connect correctly.
			Is the cable broken? Check the conductivity with a tester	Replace the cable.

11-3 List of servo alarms and warnings

No	Abbrev.	Name	RS	A/C	No	Abbrev.	Name	RS	A/C
10					50	OL1	Overload detection 1	NR	A
11	ASE	Axis selection error	AR	V4	51	OL2	Overload detection 2	NR	A
12	ME	Memory error	AR	C	52	OD1	Excessive error 1 (at servo ON)	NR	A
13	SWE	Software processing error	PR	C	53	OD2	Excessive error 2 (at servo OFF)	NR	A
14	SWE2	Software processing error 2	PR	C	54	OD3	Excessive error 3 (no power)	NR	A
15					55				
16	RD1	Pole position detection error 1	PR	BV	56				
17	ADE	A/D converter error	PR	A	57				
18	WAT	Initial communication error	PR	A	58	CLG0	Collision detection method 1 - G0	NR	A
19					59	CLG1	Collision detection method 1 - G1	NR	A
1A	Stei	Initial communication error (SUB)	PR	A	5A	CLT2	Collision detection method 2	NR	A
1B	Scpu	CPU error (SUB)	PR	A	5B				
1C	Sled	EPROM/LED error (SUB)	PR	A	5C	ORFE	Orientation feedback error	NR	SP
1D	Sdat	Data error (SUB)	PR	A	5D				
1E	Sohe	ROM-RAM/thermal error (SUB)	PR	A	5E				
1F	Stre	Serial detector communication error (SUB)	PR	A	5F				
20	NS1	No signal 1	PR	BV	60	0	Instantaneous power failure	PR	R
21	NS2	No signal 2	PR	V4	61	1	Power module overcurrent	PR	V
22					62	2			
23	OSE	Excessive speed deflection	PR	SP	63	3	Auxiliary circuit error	PR	V
24					64	4			
25	ABSE	Absolute position lost	AR	V4	65	5	Rush relay error	PR	V/R
26	NAE	Non-used axis error	PR	V4	66	6			
27	SCcpu	Scale CPU error (SUB)	PR	A	67	7	Open phase	PR	V
28	Sosp	Scale overspeed (SUB)	PR	A	68	8	Watch dog	AR	V/R
29	Sabs	Absolute position detection circuit error (SUB)	PR	A	69	9	Ground fault	PR	V
2A	Sinc	Incremental position detection circuit error (SUB)	PR	A	6A	A	Contactor melting	PR	V
2B	SCPU	CPU error	PR	A	6B	B	Rush relay melting	PR	V/R
2C	SLED	EEPROM/LED error	PR	A	6C	C	Main circuit error	PR	V/R
2D	SDAT	Data error	PR	A	6D	D			
2E	SRRE	ROM-RAM error	PR	A	6E	E	Memory error	AR	V/R
2F	STRE	Serial detector communication error	PR	A	6F	F	AD error (PS error)	AR	V/R
30	OR	Over-regeneration	PR	SVJ	70	G			
31	OS	Overspeed	PR	A	71	H	Instantaneous power failure/external emergency stop	NR	V
32	PMOC	Overcurrent (IPM error)	PR	A	72	I			
33	OV	Over voltage	PR	SVJ	73	J	Over-regeneration	PR	R
34	DP	CNC communication CRC error	PR	C	74	K	Regenerative resistor overheat	PR	R
35	DE	CNC communication data error	PR	A	75	L	Overvoltage	NR	V/R
36	TE	CNC communication communication error	PR	C	76	M	External emergency stop setting error	AR	V
37	PE	Initial parameter error	PR	A	77	N	Power module (V)/fin (R) overheat	PR	V/R
38	TP1	CNC communication protocol error 1	PR	C	78				
39	TP2	CNC communication protocol error 2	PR	A	79				
3A	OC	Overcurrent	PR	A	7A				
3B	PMOH	Overheat (IPM error)	PR	A	7B				
3C					7C				
3D					7D				
3E					7E				
3F					7F				
40	KE1	A-TK unit changeover error	PR	SP	80	HCN	HR unit connection error	PR	A
41	KE2	A-TK unit communication error	PR	SP	81	HHS	HR unit HSS communication error	PR	A
42	FE1	Feedback error 1	PR	V4	82	NSP	Power supply no signal	PR	AV
43	FE2	Feedback error 2	PR	A	83	HSC	HR unit scale judgment error	PR	A
44	CAXC	C axis changeover alarm	NR	SP	84	HCPU	HR unit CPU error	AR	A
45					85	HDAT	HR unit data error	PR	A
46	OHM	Motor overheat	NR	A	86	HMAG	HR unit pole error	PR	A
47					87				
48	SCCPU	Scale CPU error	PR	A	88	WD	Watch dog	AR	C
49	SOSP	Scale overspeed	PR	A	89	Hcn	HR unit connection error (SUB)	PR	A
4A	SABS	Absolute position detection circuit error	PR	A	8A	Hhs	HR unit HSS communication error (SUB)	PR	A
4B	SINC	Incremental position detection circuit error	PR	A	8B				
4C					8C	Hsc	HR unit scale judgment error (SUB)	PR	A
4D					8D	Hcpu	HR unit CPU error (SUB)	AR	A
4E					8E	Hdat	HR unit data error (SUB)	PR	A
4F					8F	Hmag	HR unit pole error (SUB)	PR	A

No	Abbrev.	Name	RS	A/C	No	Abbrev.	Name	RS	A/C
90	WST	Low-speed serial initial communication error	PR	V4	E0	WOR	Over-regeneration warning	*	SVJ
91	WAS	Low-speed serial communication error	*	V4	E1	WOL	Overload warning	*	A
92	WAF	Low-speed serial protocol error	*	V4	E2				
93	WAM	Absolute position fluctuation	PR	A	E3	WAC	Absolute position counter warning	*	V4
94					E4	WPE	Parameter error warning	*	A
95					E5				
96	MPE	MP scale feedback error	*	V4	E6	AXE	Control axis removal warning	*	A
97	MPO	MP scale offset fluctuation	PR	V4	E7	NCE	CNC emergency stop	*	C
98					E8	O	Over-regeneration warning	*	V/R
99					E9	P	Instantaneous stop warning	*	V
9A					EA	Q	External emergency stop input	*	V
9B	WMS	HR unit pole shift warning	*	A	EB	R			
9C	WMG	HR unit pole warning	*	A	EC	S			
9D	Wmg	HR unit pole warning (SUB)	*	A	ED	T			
9E	Wan	High serial multi-rotation counter error	*	V4	EE	U			
9F	WAB	Battery voltage drop	*	V4	EF	V			
A0					00				
A1					01	When rewriting the software	FLASH, programming error		
A2					02		FLASH, erase error		
A3					03		Vpp error		
A4					04		Check sum error		
A5					05		Compare error		
A6					06				
A7					07				
A8	WTW	Turret indexing command error warning	*	SP	08		Bank designation error		
A9					09		Initial address error		
AA		CNC initial communication No. 1 phase wait			0A		Bank changeover error		
AB		CNC initial communication No. 1 phase wait			0B		Address error		
AC		CNC initial communication No. 2 phase wait			0C		Reception timeout		
AD		CNC initial communication No. 3 phase wait			0D				
AE		CNC initial communication No. 4 phase wait			0E				
AF		Spare			0F		Command sequence error		

Bn		During READY OFF (n is the control axis No.)	Dn		During servo ON (n is the control axis No.)
Cn		During servo OFF (n is the control axis No.)	Fn		Control axis No. display (n is the control axis No.)

Note 1) RS: PR: Reset by turning CNC power OFF, AR: Reset by turning servo driver power OFF,
*: This is a warning display, and the servo does not turn OFF.

Note 2) A/C: A: Alarm that occurs for each axis, C: Common alarm in driver, SP: Spindle alarm, SVJ:MDS-A-SVJ alarm, AV: MDS-A-Vx alarm, BV: MDS-B-Vx alarm, V4: MDS-B-Vx4 alarm, V: Power supply regeneration power supply alarm, R: Regenerative resistance power supply alarm

11-4 Alarm details

Servo alarms

No.	Abbrev.	Name	Details	RS	A/C
12	ME	Memory error	An error was detected in the memory IC/FBIC during the self-check carried out when the driver power was turned ON. (Refer to 11-5. LED display Nos. at memory error.)	AR	C
13	SWE	Software processing error	The software data process did not end within the specified time.	PR	C
14	SWE2	Software processing error 2	The current processing processor is not operating correctly.	PR	C
17	ADE	A/D converter error	An error was detected in the current detection A/D converter during the self check by the driver.	PR	A
18	WAT	Serial detector Initial communication error	Initial communication was not possible with the detector in the system using a high-speed serial detector for the MAIN side detector.	PR	A
1A	Stei	Serial detector Initial communication error (SUB)	Initial communication was not possible with the detector in the system using a hig h-speed serial detector for the SUB side detector.	PR	A
1B	Scpu	CPU error (SUB)	An error was detected in the data stored in the EEPROM of an absolute position linear scale connected to the SUB side.	PR	A
1C	Sled	EPROM/LED error (SUB)	An error was detected in the EEPROM of an absolute position linear position linear scale connected to the SUB side.	PR	A
1D	Sdat	Data error (SUB)	An error was detected within one rotation position of an absolute position linear position linear scale connected to the SUB side.	PR	A
1E	Sohe	ROM-RAM/thermal error (SUB)	A ROM/RAM error was detected in the absolute position linear scale connected to the SUB side.	PR	A
1F	Stre	Serial detector communication error (SUB)	Communication was cut off with the high-speed serial detector connected to the SUB side.	PR	A
27	SCcpu	Absolute position detector Scale CPU error (SUB)	The CPU of the absolute position linear scale connected to the SUB side is not operating correctly.	PR	A
28	Sosp	Absolute position detector Scale overspeed (SUB)	The absolute position liner scale connected to the SUB side detected a speed of 45m/s or more when the CNC power was turned ON.	PR	A
29	Sabs	Absolute position detection circuit error (SUB)	An error was detected in the scale or scale side circuit of the absolute position linear scale connected to the SUB side.	PR	A
2A	Sinc	Incremental position detection circuit error (SUB)	A speed exceeding the max. movement speed of the absolute position linear scale connected to the SUB side was detected.	PR	A
2B	SCPU	CPU error	An error was detected in the data stored in the EEPROM of an absolute position linear scale connected to the MAIN side.	PR	A
2C	SLED	EEPROM/LED error	An error was detected in the EEPROM of an absolute position linear position linear scale connected to the MAIN side.	PR	A
2D	SDAT	Data error	An error was detected within one rotation position of an absolute position linear position linear scale connected to the MAIN side.	PR	A
2E	SRRE	ROM-RAM error	A ROM/RAM error was detected in the absolute position linear scale connected to the MAIN side.	PR	A
2F	STRE	Serial detector communication error	Communication was cut off with the high-speed serial detector connect ed to the MAIN side.	PR	A
31	OS	Over speed	A speed exceeding the linear scale's tolerable speed was detected.	PR	A
32	PMOC	IPM error (Overcurrent)	The IPM used for the inverter detected an overcurrent.	PR	A
34	DP	CNC communication CRC error	An error was detected in the data sent from the CNC to the driver.	PR	C
35	DE	CNC communication data error	An error was detected in the movement command data from the CNC.	PR	A
36	TE	CNC communication communication error	The communication from the CNC was cut off.	PR	C
37	PE	Initial parameter error	An illegal parameter was detected in the parameters sent when the CNC power was turned ON. (Refer to 11-6. Error parameter Nos. at initial parameter error.)	PR	A
38	TP1	CNC communication protocol error 1	An error was detected in the communication frame sent from the CNC.	PR	C
39	TP2	CNC communication protocol error 2	An error was detected in the axis information data sent from the CNC.	PR	A
3A	OC	Overcurrent	An excessive current was detected in the motor drive current.	PR	A
3B	PMOH	IPM error (Overheat)	The IPM used for the inverter detected overheating.	PR	A
43	FE2	Feedback error 2	An excessive deviation of the feedback amount for the MAIN side detector and SUB side detected was detected in the 2-scale 2-motor (2-amplifier) control.	PR	A
46	OHM	Motor overheat	A temperature error was detected in the motor being driven.	NR	A
48	SCCPU	Scale CPU error	The CPU in the absolute position linear scale connected to the MAIN side is not operating correctly.	PR	A

No.	Abbrev.	Name	Details	RS	A/C
49	SOSP	Scale overspeed	The absolute position liner scale connected to the MAIN side detected a speed of 45m/s or more when the CNC power was turned ON.	PR	A
4A	SABS	Absolute position detection circuit error	An error was detected in the scale or scale side circuit of the absolute position linear scale connected to the MAIN side.	PR	A
4B	SINC	Incremental position detection circuit error	A speed exceeding the max. movement speed of the absolute position linear scale connected to the MAIN side was detected.	PR	A
50	OL1	Overload detection 1	The servomotor or servo driver load level obtained from the motor current reached the overload level set with the overload detection level (SV022:OLL).	NR	A
51	OL2	Overload detection 2	A current command exceeding 95% of the driver's max. capacity continued for 1 sec. or more.	NR	A
52	OD1	Excessive error 1 (at servo ON)	The difference of the ideal position and actual position exceeded the parameter SV023:OD1 (or SV053:OD3) at servo ON.	NR	A
53	OD2	Excessive error 2 (at servo OFF)	The difference of the ideal position and actual position exceeded parameter SV026:OD2 at servo OFF.	NR	A
54	OD3	Excessive error 3 (no power)	The motor current is not flowing when the excessive error alarm 1 was detected. This occurs when the power line connection is incorrect or broken, or when there is no bus voltage.	NR	A
58	CLE0	Collision detection method	A collision detection method 1 error was detected during the G0 modal (rapid traverse).	NR	A
59	CLE1	Collision detection method 1	A collision detection method 1 error was detected during the G1 modal (cutting feed).	NR	A
5A	CLE2	Collision detection method 2	A collision detection method 2 error was detected.	NR	A
6F	PSE	Power supply alarm	The power supply is not connected. An error was detected in the power supply AD converter.	AR	C
80	HCN	HR unit connection error	An incorrect connection or cable breakage was detected in the MDS-B-HR connected to the MAIN side.	PR	A
81	HHS	HR error HSS communication error	The MDS-B-HR connected to the MAIN side detected an error in the communication with the absolute position linear scale.	PR	A
83	HSC	HR unit scale judgment error	The MDS-B-HR connected to the MAIN side could not judge the analog frequency of the connected linear scale.	PR	A
84	HCPU	HR unit CPU error	The CPU of the MDS-B-HR connected to the MAIN side is not operating correctly.	AR	A
85	HDAT	HR unit data error	An error was detected in the analog interpolation data of the MDS-B-HR connected to the MAIN side.	PR	A
86	HMAG	HR unit pole error	An error was detected in the pole data of the MDS-B-HR connected to the MAIN side.	PR	A
88	WD	Watch dog	The servo system is not operating correctly.	AR	C
89	Hcn	HR unit connection error (SUB)	An incorrect connection or cable breakage was detected in the MDS-B-HR connected to the SUB side.	PR	A
8A	Hhs	HR unit HSS communication error (SUB)	The MDS-B-HR connected to the SUB side detected an error in the communication with the absolute position linear scale.	PR	A
8C	Hsc	HR unit scale judgment error (SUB)	The MDS-B-HR connected to the SUB side could not judge the analog frequency of the connected linear scale.	PR	A
8D	Hcpu	HR unit CPU error (SUB)	The CPU of the MDS-B-HR connected to the SUB side is not operating correctly.	AR	A
8E	Hdat	HR unit data error (SUB)	An error was detected in the analog interpolation data of the MDS-B-HR connected to the SUB side.	PR	A
8F	Hmag	HR unit pole error (SUB)	An error was detected in the pole data of the MDS-B-HR connected to the SUB side.	PR	A

Servo warnings

No.	Abbrev.	Name	Details	RS	A/C
98	WAM	Absolute position fluctuation	A fluctuation exceeding the tolerable value was detected in the absolute position detected when the CNC power is turned ON.	*	A
9B	WMS	HR unit pole shift warning	An error was detected in the pole shift amount set in SV028 (MSFT).	*	A
9C	WMG	HR unit pole warning	An error was detected in the pole position data of the MDS-B-HR connected to the MAIN side after passing the Z phase.	*	A
9D	Wmg	HR unit pole warning (SUB)	An error was detected in the pole position data of the MDS-B-HR connected to the SUB side after passing the Z phase.	*	A
E1	WOL	Overload warning	An level 80% of the overload alarm 1 was detected.	*	A
E4	WPE	Parameter error warning	A parameter exceeding the setting range was set.	*	A
E6	AXE	Control axis removal warning	The control axis is being removed.	*	A
E7	NCE	CNC emergency stop	The CNC is in the emergency stop state.	*	C

11-5 LED display Nos. at memory error

When a memory error (alarm 12) occurs, in most cases the connection with the CNC is not being executed. Normally, if the connection is not executed even when the connected with the CNC, check whether a memory error (alarm 12) has occurred by reading the LED display on the servo driver.

The faulty section can be pinpointed by reading the No. displayed on the LED. (Refer to the following table.)

No.	Details	Time of occurrence	Alarm display
–	Power PCB ID error	When CNC power is turned ON	Normal alarm display
01	LSI internal RAM error 1	When servo driver power is turned ON	12 and No. flicker on LED (Not connected with CNC)
02	LSI internal RAM error 2		
03	LSI transmission buffer error		
04	LSI reception buffer error		
05	External SRAM error		
11	LSI timing status error		
21	LSI encoder I/F counter error L axis MAIN		
22	LSI encoder I/F counter error L axis SUB		
23	LSI encoder I/F counter error L axis MAIN		
24	LSI encoder I/F counter error L axis SUB		
31	External FLASH boot code error 1		
32	External FLASH check sum error 1		
33	External FLASH boot code error 2		
34	External FLASH check sum error 2		
41	CPU internal RAM error 1		
42	CPU internal RAM error 2	When CNC power is turned ON	
51	Driver model error		

11-6 Error parameter Nos. at initial parameter error

When an initial parameter error (alarm 37) occurs, the erroneous parameter is displayed on the CNC Diagnosis screen.
The display method differs according to the CNC being used, so refer to the instruction manual for the respective CNC.

The No. displayed here is normally the parameter No. (SV00xx).
In addition, there is a special 3-digit No. (Refer to following table.)
In this case, multiple related parameters are occurring, so correctly set the related parameters.

No.	Details	Related parameter
69	The max. rapid traverse speed setting value set in the CNC is incorrect. This normally will not occur, and is a problem in the CNC system software.	CNC axis parameter rapid
71	The max. cutting speed setting value set in the CNC is incorrect. This normally will not occur, and is a problem in the CNC system software.	CNC axis parameter clamp
101	The constants used with the following functions are overflowing. Electronic gears Position loop gain Speed feedback conversion Confirm that each related parameter is correctly set.	SV001:PC1,SV002:PC2 SV003:PGN1,SV018:PIT SV019:RNG1,SV020:RNG2 SV049:PGN1sp
102	Turn the absolute position detection parameter OFF. The connected detector is an incremental specification detector, so to carry out absolute position detection, connect an absolute position specification detector.	SV017:SPEC,SV025:MTYP
103	There is no servo option. The closed loop (including ball screw end detection) and dual feedback control function are options.	SV025:MTYP/pen SV017:SPEC/dfbx
104	There is no servo option. The SHG control function is an option.	SV057:SHGC SV058:SHGCsp
105	There is no servo option. The adaptive filter function is an option.	SV027:SSF1/aflt

11-7 Troubleshooting for each servo alarm

[Alarm/warning check timing]

f1: When servo driver power is turned ON
f2: When CNC power supply is turned ON (emergency stop ON)
f3: During normal operation (servo ON)
f4: During axis removal (ready ON, servo OFF)

(Note) Note that warning "93" could occur even when the axis is reinstalled after removal.

Alarm No. 12	Memory error: Error in drive unit memory IC (SRAM, FROM)	**Alarm check timing**			
		f1	f2	f3	f4
		○	–	–	–

	Investigation details	**Investigation results**	**Remedies**
1	Check the repeata bility.	The error is always repeated.	Replace the drive unit.
		The state returns to normal once, but occurs sometimes thereafter.	Investigate item 2.
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 13	Software process error: The driver's software processing time did not end within the specified time, or an illegal IT process was carried out.	**Alarm check timing**			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	**Investigation results**	**Remedies**
1	Check whether the servo software version was changed recently.	The version was changed.	Try replacing with the drive unit containing the original software version.
		The version was not changed.	Investigate item 2.
2	Check the repeatability.	The error is always repeated.	Replace the drive unit.
		The state returns to normal once, but occurs sometimes thereafter.	Investigate item 3.
3	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 14	Software processing error 2: The current loop process, of the driver software processing times, did not end within the specified time.	**Alarm check timing**			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	**Investigation results**	**Remedies**
1	Check whether the servo software version was changed recently.	The version was changed.	Try replacing with the drive unit containing the original software version.
		The version was not changed.	Investigate item 2.
2	Check the repeatability.	The error is always repeated.	Replace the drive unit.
		The state returns to normal once, but occurs sometimes thereafter.	Investigate item 3.
3	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 17	A/D converter error: There is an error in the drive unit's A/D converter.	Alarm check timing			
		f1	f2	f3	f4
		–	○	–	–

	Investigation details	Investigation results	Remedies
1	Check the repeatability.	The error is always repeated.	Replace the drive unit.
		The state returns to normal once, but occurs sometimes thereafter.	Investigate item 2.
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 18	Initial communication error: Initial communication was not possible with the detector in the system using a high-speed serial detector for the MAIN side detector.	Alarm check timing			
		f1	f2	f3	f4
		–	○	–	–

	Investigation details	Investigation results	Remedies
1	Check the servo parameter (SV025) setting value.	The value is not set correctly.	Correctly set VO205.
		The value is set correctly.	Investigate item 2.
2	Wiggle the connectors by hand to check whether the detector connectors (driver side and detector side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 3.
3	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 4.
4	Connect to another normal axis driver, and check whether the fault is on the driver side or detector side.	The alarm is on the driver side.	Replace the drive unit.
		The alarm is on the detector side.	Investigate item 5.
5	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 1A	Serial detector initial communication error (SUB): Initial communication was not possible with the detector in the system using a high-speed serial detector for the SUB side detector.	Alarm check timing			
		f1	f2	f3	f4
		–	○	–	–

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "18" items.		

⚠ CAUTION

To prevent trouble, when changing the motor and driver combination, avoid driving a driver with a larger capacity than the specified driver using the motor. The motor could be demagnetized. Note that this combination can be used for checking in the emergency stop state. The motor can be driven with a driver with a capacity smaller than the specifications.

Alarm No. 1B	CPU error (SUB): An error was detected in the data stored in the EEPROM of an absolute position linear scale connected to the SUB side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Wiggle the connectors by hand to check whether the absolute position linear scale connectors (driver side and scale side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 2.
2	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 3.
3	Connect to another normal axis driver, and check whether the fault is on the driver side or scale side.	The alarm is on the driver side.	Replace the drive unit.
		The alarm is on the absolute position linear scale side.	Investigate item 4.
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the absolute position linear scale.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 1C	EEPROM/LED error (SUB): An error was detected in the EEPROM of an absolute position linear position linear scale connected to the SUB side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "1B" items.		

Alarm No. 1D	Data error (SUB): An error was detected within one rotation position of an absolute position linear position linear scale connected to the SUB side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "1B" items.		

Alarm No. 1E	ROM, RAM/thermal error (SUB): A ROM/RAM error was detected in the absolute position linear scale connected to the SUB side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "1B" items.		

Alarm No. 1F	Serial detector communication error (SUB) Communication was cut off with the detector in the absolute position scale connected to the SUB side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check items 2 and following for alarm No. "18".		

Alarm No. 27	Scale CPU error (SUB): The CPU of the absolute position linear scale connected to the SUB side is not operating correctly.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Wiggle the connectors by hand to check whether the absolute position linear scale connectors (unit side and scale side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 2.
2	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 3.
3	Connect to another normal axis unit, and check whether the fault is on the unit side or scale side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the absolute position linear scale side.	Investigate item 4.
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the absolute position linear scale.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 28	Scale overspeed (SUB): The absolute position liner scale connected to the SUB side detected a speed of 45m/sec or more when the CNC power was turned ON.	Alarm check timing			
		f1	f2	f3	f4
		–	○	–	–

	Investigation details	Investigation results	Remedies
1	Check that the system is an absolute position linear scale specification system.	The system is not the absolute position linear scale specifications.	Correctly set the SV025: MTYP parameter.
		The system is the absolute position linear scale specifications.	Investigate item 2.
2	Check whether the machine was operating when the alarm occurred.	The machine was operating.	Check the motor's mechanical brakes and machine system.
		The machine was not operating.	Investigate item 3.
3	Wiggle the connectors by hand to check whether the absolute position linear scale connectors (unit side and scale side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 4.
4	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 5.
5	Connect to another normal axis unit, and check whether the fault is on the unit side or detector side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the absolute position linear scale side.	Investigate item 6.
6	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the absolute position linear scale.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding .... Additionally ground.

⚠ CAUTION

To prevent trouble, when changing the motor and driver combination, avoid driving a driver with a larger capacity than the specified driver using the motor. The motor could be demagnetized. Note that this combination can be used for checking in the emergency stop state. The motor can be driven with a driver with a capacity smaller than the specifications.

Alarm No. 29	Absolute position detection circuit error (SUB): An error was detected in the scale or scale side circuit of the absolute position linear scale connected to the SUB side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "28" items.		

Alarm No. 2A	Incremental position detection circuit error (SUB): A speed exceeding the max. movement speed of the absolute position linear scale connected to the SUB side was detected.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check whether the machine was operating when the alarm occurred.	The machine was operating.	Investigate item 3.
		The machine was not operating.	Investigate item 2.
2	Check whether the operation is normal at low-speeds.	The machine was operating.	Investigate item 3.
		The machine was not operating.	Check the precautions for turning the power ON. • Wiring check • Parameter check
3	Wiggle the connectors by hand to check whether the absolute position linear scale connectors (unit side and scale side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 4.
4	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 5.
5	Connect to another normal axis unit, and check whether the fault is on the unit side or detector side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the absolute position linear scale side.	Investigate item 6.
6	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the motor (the absolute position linear scale).
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 2B	CPU error: An error was detected in the data stored in the EEPROM of an absolute position linear scale connected to the MAIN side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check items 3 and following for alarm No. "2A".		

Alarm No. 2C	EEPROM/LED error: An error was detected in the EEPROM of an absolute position linear position linear scale connected to the MAIN side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check items 3 and following for alarm No. "2A".		

Alarm No. 2D	Date error: An error was detected within one rotation position of an absolute position linear position linear scale connected to the MAIN side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check items 3 and following for alarm No. "2A".		

Alarm No. 2E	ROM/RAM error: A ROM/RAM error was detected in the absolute position linear scale connected to the MAIN side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check items 3 and following for alarm No. "2A".		

Alarm No. 2F	Serial detector communication error: Communication was cut off with detector of the absolute position linear scale connected to the MAIN side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check items 2 and following for alarm No. "18".		

Alarm No. 31	Overspeed: Movement was carried out at a speed exceeding the linear motor's tolerable speed.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check whether the machine was operating when the alarm occurred.	The machine was operating.	Investigate item 4.
		The machine was not operating.	Investigate item 2.
2	Check whether the operation is normal at low-speeds.	The machine was operating.	Investigate item 3.
		The machine was not operating.	Check the precautions for turning the power ON. • Wiring check • Parameter check
3	Check whether the rapid traverse speed is too high.	The speed is too high.	Lower the speed to below the rated speed.
		The speed is set below the rated speed.	Investigate item 4.
4	Check whether the acceleration/ deceleration constant is too small. • Check the current value display on the Servo Monitor screen.	A value that is 80% or more of the max. value is displayed.	Reduce the rapid traverse time constant so that the current value on the Servo Monitor screen is 80% or less of the max. value during rapid traverse acceleration/deceleration.
		The value is 80% or less of the max. value.	Investigate item 5.
5	Check items 2 and following for alarm No. "18".		

⚠ CAUTION

To prevent trouble, when changing the motor and driver combination, avoid driving a driver with a larger capacity than the specified driver using the motor. The motor could be demagnetized. Note that this combination can be used for checking in the emergency stop state. The motor can be driven with a driver with a capacity smaller than the specifications.

Alarm No. 32	Power module error (Overcurrent): The IPM used for the inverter detected an overcurrent.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check whether the unit's output U, V and W phases are short circuited. • Disconnect the U V W connection from the terminal block and the motor's cannon plug, and check between UVW with a tester.	The phases are short circuited or there is no continuity.	Replace the UVW wires.
		The phases are normal.	Investigate item 2.
2	Check whether there is a ground fault in the UVW wires. • Check between the UVW wires and ground with a tester in the state given in item 1.	The phases are short circuited or there is no continuity.	Replace the UVW wires.
		The phases are normal.	Investigate item 3.
3	Check whether there is a ground fault in the motor. • Check between the motor's UVW wires and ground with a tester (megger) in the state given in item 1.	The phases are short circuited or there is no continuity.	Replace the motor.
		The phases are normal. (same level as other axes)	Investigate item 4.
4	Check the servo parameter setting values. Refer to the adjustment procedures.	The settings are incorrect.	Correctly set.
		The settings are correct.	Investigate item 5.
5	Wiggle the connectors by hand to check whether the detector connectors (unit side and detector side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 6.
6	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 7.
7	Check the repeatability.	The alarm is not repeated.	Investigate item 9.
		The alarm is repeated sometimes.	Investigate item 9.
		The alarm is always repeated.	Investigate item 8.
8	Connect to another normal axis driver, and check whether the fault is on the unit side or scale side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the detector.	Replace the motor (the detector).
9	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Monitor the state for a while.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding .... Additionally ground.

Alarm No. 34	CNC communication CRC error: An error was detected in the data sent from the CNC to the driver.	Alarm check timing			
		f1	F2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Wiggle the connection cables by hand between the CNC and drive unit, between the battery unit and drive unit, and between the drive units to see if any of the connectors are loose. Check whether any force is being applied on the connectors.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 2.
2	Turn the power OFF, and check the connection of the communication cables listed in item 1. Try replacing the cables with normal ones.	There is a connection fault.	Replace the communication cable.
		The connection is normal.	Investigate item 3.
3	Check whether the CNC and drive unit software versions have been changed recently.	The version was changed.	Replace with the original software version.
		The version was not changed.	Investigate item 4.
4	Try replacing with another unit to determine whether the fault is on the CNC side or units side.	The alarm is on the unit side.	Replace the drive unit.
		The driver is not the cause.	Investigate item 5.
5	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the MCP card on the CNC side.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 35	CNC communication data error: An error was detected in the movement command data from the CNC.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	–

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "34" items.		

Alarm No. 36	CNC communication, communication error: The communication from the CNC was cut off.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	–

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "34" items.		

⚠ CAUTION

To prevent trouble, when changing the motor and driver combination, avoid driving a driver with a larger capacity than the specified driver using the motor. The motor could be demagnetized. Note that this combination can be used for checking in the emergency stop state. The motor can be driven with a driver with a capacity smaller than the specifications.

Alarm No. 37	Initial parameter error: An illegal parameter was detected in the parameters sent when the CNC power was turned ON.	Alarm check timing			
		f1	f2	f3	f4
		–	○	–	○

	Investigation details	Investigation results	Remedies
1	The illegal parameter No. will appear on the CNC Diagnosis screen, so check that servo parameter with the parameter adjustment procedures.	The parameter is incorrect.	Set to the correct parameter.
		The parameter is correct.	Investigate item 3.
		The parameter No. is not 1 to 64.	If the No. is 101, check investigation item 2.
2	Check whether the servo parameter (PIT) (RNG1) (RNG2) (PC1) and (PC2) combination is illegal, or whether the setting range is exceeded.	The combination is illegal, or the setting range is exceeded.	Refer to the parameter settings in the specifications and to the supplements, and set to the correct values.
		The parameter is correct.	Investigate item 3.
3	Check the alarm No. "34" items.		

Alarm No. 38	CNC communication protocol error 1: An error was detected in the communication frame sent from the CNC.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "34" items.		

Alarm No. 39	CNC communication protocol error 2 An error was detected in the axis information data sent from the CNC.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "34" items.		

Alarm No. 3A	Overcurrent: An excessive current was detected in the motor drive current.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "32" items.		

Alarm No. 3B	Power module error (Overheat): The IPM used for the inverter detected overheating.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies	
1	Check the heat radiation environment.			
	(1) Rotation of fan on back of unit.	The fan is not rotating correctly.	Replace the fan.	Make sure that cutting oil and cutting chips do not get on the fins.
	(2) Contamination of heat radiation fins on back of unit.	The heat radiation fins are heavily contaminated with cutting oil or cutting chips, etc.	Clean the fin.	
	(3) Measurement of unit's ambient temperature.	The temperature exceeds 55°C.	Reconsider the panel ventilation and cooling.	
		Nothing corresponds.	Investigate item 2.	
2	Check for effects in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	The grounding is incomplete. If a certain device operations, the alarm occurs easily.	Correctly ground. Take noise measures for the device on the left.	
		No problems.	Replace the drive unit.	

Alarm No. 43	Feedback error 2: An excessive deviation of the feedback amount for the MAIN side detector and SUB side detected was detected in the 2-scale 2-motor (2-amplifier) control.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	–

	Investigation details	Investigation results	Remedies
1	Check items 3 and following for alarm No. "2A".		

Alarm No. 46	Motor overheat: A temperature error was detected in the motor being driven.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	–

	Investigation details	Investigation results	Remedies
1	Check whether the specifications provide the motor thermal.	The specifications do not provide the motor thermal.	Investigate item 2.
		The specifications provide the motor thermal.	Investigate item 3.
2	Check the servo parameter (SV034) setting value.	The parameter is not set correctly.	Correctly set SV034/mohm
		The parameter is set correctly.	Investigate item 3.
3	Check the repeatability.	The alarm is repeated within one minute after startup.	Investigate item 5.
		The alarm is repeated sometimes after operating for a while.	Investigate item 4.
4	Check the motor temperature when the alarm occurs.	The motor is hot.	Ease the operation pattern. ↓ If the problem is not solved, check investigation item 5.
		The motor is not high.	Investigate item 5.
5	Wiggle the connectors by hand to check whether the detector connectors (unit side and motor side cannon) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 6.
6	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 7.
7	Connect to another normal axis unit, and check whether the fault is on the unit side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm occurs even when the unit is replaced.	Investigate item 8.
8	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the motor.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

⚠ CAUTION

To prevent trouble, when changing the motor and driver combination, avoid driving a driver with a larger capacity than the specified driver using the motor. The motor could be demagnetized. Note that this combination can be used for checking in the emergency stop state. The motor can be driven with a driver with a capacity smaller than the specifications.

Alarm No. 48	Scale CPU error: The CPU of the absolute position linear scale connected to the MAIN side is not operating correctly.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Wiggle the connectors by hand to check whether the absolute position linear scale connectors (unit side and scale side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 2.
2	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 3.
3	Connect to another normal axis unit, and check whether the fault is on the unit side or scale side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the absolute position linear scale side.	Investigate item 4.
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the absolute position linear scale.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding .... Additionally ground.

Alarm No. 49	Scale overspeed: The absolute position liner scale connected to the MAIN side detected a speed of 45m/sec or more when the CNC power was turned ON.	Alarm check timing			
		f1	f2	f3	f4
		–	○	–	–

	Investigation details	Investigation results	Remedies
1	Check that the system is an absolute position linear scale specification system.	The system is not the absolute position linear scale specifications.	Correctly set the SV025: MTYP parameter.
		The system is the absolute position linear scale specifications.	Investigate item 2.
2	Check whether the machine was operating when the alarm occurred.	The machine was operating.	Check the motor's mechanical brakes and machine system.
		The machine was not operating.	Investigate item 3.
3	Wiggle the connectors by hand to check whether the absolute position linear scale connectors (unit side and scale side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 4.
4	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 5.
5	Connect to another normal axis unit, and check whether the fault is on the unit side or detector side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the absolute position linear scale side.	Investigate item 6.
6	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the absolute position linear scale.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding .... Additionally ground.

Alarm No. 4A	Absolute position detection circuit error: An error was detected in the scale or scale side circuit of the absolute position linear scale connected to the MAIN side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "49" items.		

Alarm No. 4B	Incremental position detection circuit error: A speed exceeding the max. movement speed of the absolute position linear scale connected to the MAIN side was detected.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check whether the machine was operating when the alarm occurred.	The machine was operating.	Investigate item 3.
		The machine was not operating.	Investigate item 2.
2	Check whether the operation is normal at low-speeds.	The machine was operating.	Investigate item 3.
		The machine was not operating.	Check the precautions for turning the power ON. • Wiring check • Parameter check
3	Wiggle the connectors by hand to check whether the absolute position linear scale connectors (unit side and scale side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 4.
4	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 5.
5	Connect to another normal axis unit, and check whether the fault is on the unit side or detector side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the absolute position linear scale side.	Investigate item 6.
6	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the motor (the absolute position linear scale).
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding .... Additionally ground.

⚠ CAUTION

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Alarm No. 50	Overload 1: The servomotor or servo driver load level obtained from the motor current reached the overload level set with the overload detection level (SV022:OLL).	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the servo parameter (OLL) setting value. Standard setting value OLL: 150.	The value differs from the standard setting value.	When not using special specifications, set the value to the standard setting value.
		The value is the standard setting value.	Investigate item 2.
2	Check the motor temperature when the alarm occurs.	The motor is hot.	Ease the operation pattern. ↓ If the problem is not solved, check investigation item 3.
		The motor is not high.	Investigate item 3.
3	Check whether the motor is hunting.	The motor is hunting.	Refer to the adjustment procedures and readjust. • Check the cable wiring and connector connection. • Check for incorrect parameter settings. • Adjust the gain. ↓ If the problem is not resolved, check investigation item 4.
		The motor is not hunting.	Investigate item 4.
4	Connect to another normal axis unit, and check whether the fault is on the unit side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm occurs even when the unit is replaced.	Investigate item 5.
5	Check whether the current value on the CNC Servo Monitor screen is an abnormally large value when stopped and operating.	An abnormal value is displayed.	Check the machine system.
		A correct value is displayed.	Investigate item 6.
6	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the motor (the detector).
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 51	Overload 2: A current command exceeding 95% of the driver's max. capacity continued for 1 sec. or more.	Alarm check timing			
		f1	f2	f3	f4
		–	–	○	–

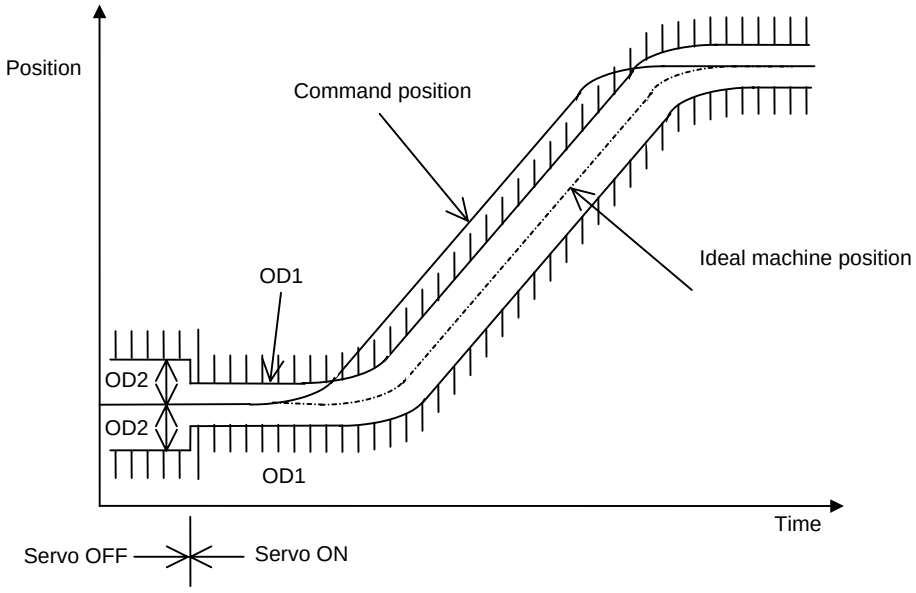
	Investigation details	Investigation results	Remedies
1	Check whether the PN power is supplied to the driver. • Check the axis for which the alarm is occurring and the axis farthest from the power supply.	The voltage is being supplied.	Investigate item 3.
		The voltage is not being supplied.	Investigate item 2.
2	Check whether the power supply unit's CHARGE lamp is lit, and the PN terminal voltage.	There is no voltage at the PN terminal. (The lamp is not lit.)	Check the power supply unit.
		There is voltage at the PN terminal.	Check the PN wiring between the units.
3	Check whether the current value on the CNC Servo Monitor screen is an abnormally large value during acceleration/deceleration.	The max. value is exceeding the x level given on the previous page.	Increase the acceleration/deceleration time constant to lower to approx. 80% of the limit value.
		A correct value is displayed.	Investigate item 4.
4	Check items 3 and following for alarm No. "50".		

Alarm No. 52	Excessive error 1: The difference of the ideal position and actual position exceeded the parameter SV023:OD1 (or SV053:OD3) at servo ON.	Alarm check timing			
		f1	f2	f3	f4
		–	–	○	–

	Investigation details	Investigation results	Remedies
1	Check whether the PN power is supplied to the driver. • Check the axis for which the alarm is occurring and the axis farthest from the power supply.	The voltage is being supplied.	Investigate item 3.
		The voltage is not being supplied.	Investigate item 2.
2	Check whether the power supply unit's CHARGE lamp is lit, and the PN terminal voltage.	There is no voltage at the PN terminal. (The lamp is not lit.)	Check the power supply unit.
		There is voltage at the PN terminal.	Check the PN wiring between the units.
3	Check the servo parameter (OD1) setting value.	The value differs from the standard setting value.	When not using special specifications, set the value to the standard setting value.
		The value is the standard setting value.	Investigate item 4.
4	Check items 3 and following for alarm No. "50".		

Supplement

Depending on the ideal machine position in respect to the command position, the actual machine position could enter the actual shaded section shown below, which is separated more than the distance set in OD1.



⚠ CAUTION

To prevent trouble, when changing the motor and driver combination, avoid driving a driver with a larger capacity than the specified driver using the motor. The motor could be demagnetized. Note that this combination can be used for checking in the emergency stop state. The motor can be driven with a driver with a capacity smaller than the specifications.

Alarm No. 53	Excessive error 2: The difference of the ideal position and actual position exceeded parameter SV026:OD2 at servo OFF.	Alarm check timing			
		f1	f2	f3	f4
		–	○	–	–

	Investigation details	Investigation results	Remedies
1	Check the servo parameter (OD2) setting value.	The value differs from the standard setting value.	When not using special specifications, set the value to the standard setting value.
		The value is the standard setting value.	Investigate item 2.
2	Check whether the machine is moving during servo OFF.	The machine was operating.	Check the machine and mechanical brakes.
		The machine was not operating.	Investigate item 3.
3	Wiggle the communication cable between the CNC and final connector by hand to check whether the detector connectors (unit side and CNC side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 4.
4	Turn the power OFF, and check the communication cable connection with a tester. Try replacing with normal cables.	There is a connection fault.	Replace the communication cable.
		The connection is normal.	Investigate item 5.
5	Replace with another normal axis unit, and check whether the fault is in the unit.	The alarm is on the unit side.	Replace the drive unit.
		The alarm occurs even when the unit is replaced.	Replace the MCP card on the CNC side. ↓ If the problem is not resolved, check investigation item 6.
6	Wiggle the connectors by hand to check whether the detector connectors (unit side and motor side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 7.
7	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.
		The connection is normal.	Investigate item 8.
8	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the motor.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding .... Additionally ground.

Alarm No. 54	Excessive error 3: The motor current is not flowing when the excessive error alarm 1 was detected.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	–

	Investigation details	Investigation results	Remedies
1	Check whether the PN power is supplied to the driver. • Check the axis for which the alarm is occurring and the axis farthest from the power supply.	The voltage is being supplied.	Investigate item 3.
		The voltage is not being supplied.	Investigate item 2.
2	Check whether the power supply unit's CHARGE lamp is lit, and the PN terminal voltage.	There is no voltage at the PN terminal. (The lamp is not lit.)	Check the power supply unit.
		There is voltage at the PN terminal.	Check the PN wiring between the units.
3	Check whether the motor power line is connected to the motor. • Disconnect the power line from the terminal block, and check between UVW with a tester.	The power line is not connected or is disconnected.	Increase the acceleration/deceleration time constant to lower to approx. 80% of the limit value.
		The power line is correctly connected.	Investigate item 4.
4	Replace with another normal unit, and check whether the fault is in the unit.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the motor side.	Replace the motor.

Alarm No. 58	Collision detection 0: A collision detection method 1 error was detected during the G0 modal (rapid traverse). (A disturbance torque exceeding the tolerable disturbance torque was detected.)	Alarm check timing			
		f1	f2	f3	f4
		–	–	○	–

	Investigation details	Investigation results	Remedies
1	Check whether the collision detection function is being used. Check whether the machine is colliding.	The collision detection function is not being used.	Investigate item 2.
		The motor is colliding.	Improve so that the machine does not collide.
		The collision detection is being used, but the machine is not colliding.	Investigate item 3.
2	Check the parameter. Is SV060 (TLTM) set to "0"?	The setting is incorrect.	Set SV060 (TLMT) to "0".
3	Check whether the current during normal rapid traverse acceleration/ deceleration has reached the current limit value, or whether it is 90% or more of the limit value.	The current is 90% or more of the current limit value.	Lengthen the time constant, and check investigation item 4.
		The current is less than 90% of the current limit value.	Investigate item 4.
4	Readjust the collision detection function, and then operate. (Refer to the separate collision detection function specifications.)	The alarm does not occur.	————————
		The alarm occurs.	Investigate item 5.
5	Is the machine or current vibrating?	They are vibrating.	Eliminate the vibration by adjusting the gain, and check investigation item 4.
		They are not vibrating.	Investigate item 6.
6	Raise the detection level.	The alarm does not occur.	If the problem is not resolved even after replacing the drive unit, raise the level.
		The alarm occurs.	Replace the drive unit.

⚠ CAUTION

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Alarm No. 59	Collision detection 1: A collision detection method 1 error was detected during the G1 modal (cutting feed). (A disturbance torque exceeding the tolerable disturbance torque was detected.)	Alarm check timing			
		f1	f2	f3	f4
		–	–	○	–

	Investigation details	Investigation results	Remedies
1	Check whether the collision detection function is being used. Check whether the machine is colliding.	The collision detection function is not being used.	Investigate item 2.
		The motor is colliding.	Improve so that the machine does not collide.
		The collision detection is being used, but the machine is not colliding.	Investigate item 2.
2	Check the parameter. Is SV060 (TLTM) set to "0"?	The setting is incorrect.	Set SV060 (TLMT) to "0".
3	Check whether the current during normal rapid traverse acceleration/ deceleration has reached the current limit value, or whether it is 90% or more of the limit value.	The current is 90% or more of the current limit value.	Lengthen the time constant, and check investigation item 4.
		The current is less than 90% of the current limit value.	Investigate item 4.
4	Readjust the collision detection function, and then operate. (Refer to the separate collision detection function specifications.)	The alarm does not occur.	———
		The alarm occurs.	Investigate item 5.
5	Is the machine or current vibrating?	They are vibrating.	Eliminate the vibration by adjusting the gain, and check investigation item 4.
		They are not vibrating.	Investigate item 6.
6	Raise the detection level.	The alarm does not occur.	If the problem is not resolved even after replacing the drive unit, raise the level.
		The alarm occurs.	Replace the drive unit.

Alarm No. 5A	Collision detection 2: A collision detection method 2 error was detected.	Alarm check timing			
		f1	f2	f3	f4
		–	–	○	–

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "58" items.		

Alarm No. 60 to 7F	Power supply alarm: An alarm has occurred in the power supply unit.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	MDS-A/B-CV Refer to the power supply unit specifications.		

Alarm No. 80	HR unit connection error: An incorrect connection or cable breakage was detected in the MDS-B-HR connected to the MAIN side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Wiggle the connectors by hand to check whether the MDS-B-HR connectors (unit side, HR side and linear scale side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 2.
2	Turn the power OFF, and check the connection of the detector cables (between driver I/F units and between I/F unit and scale) with a tester.	There is a connection fault.	Replace the communication cable.
		The connection is normal.	Investigate item 3.
3	Connect with another normal axis unit (or MDS-B-HR) and check whether the fault is on the unit side or MDS-B-HR (linear scale) side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the MDS-B-HR (linear scale) side.	Investigate item 4.
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace MDS-B-HR (linear scale).
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 81	HR unit HSS communication error: The MDS-B-HR connected to the MAIN side detected an error in the communication with the absolute position linear scale.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "80" items.		

⚠ CAUTION

To prevent trouble, when changing the motor and driver combination, avoid driving a driver with a larger capacity than the specified driver using the motor. The motor could be demagnetized. Note that this combination can be used for checking in the emergency stop state. The motor can be driven with a driver with a capacity smaller than the specifications.

Alarm No. 83	HR unit scale judgment error: The MDS-B-HR connected to the MAIN side could not judge the analog frequency of the connected linear scale.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Wiggle the connectors by hand to check whether the MDS-B-HR connectors (unit side, HR side, linear scale side and MD side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 2.
2	Turn the power OFF, and check the connection of the detector cables (between driver and I/F units, between I/F unit and scale and between I/F unit and pole detector) with a tester.	There is a connection fault.	Replace the communication cable.
		The connection is normal.	Investigate item 3.
3	Connect with another normal axis unit (or MDS-B-HR) and check whether the fault is on the unit side or MDS-B-HR (linear scale or MDS-B-MD) side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the MDS-B-HR (linear scale or MDS-B-MD) side.	Investigate item 4.
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace MDS-B-HR (linear scale or MDS-B-MD).
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding .... Additionally ground.

Alarm No. 84	HR unit CPU error: The CPU of the MDS-B-HR connected to the MAIN side is not operating correctly.	Alarm check timing			
		f1	f2	f3	f4
		○	–	–	–

	Investigation details	Investigation results	Remedies
1	Wiggle the connectors by hand to check whether the MDS-B-HR connectors (unit side and HR side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 2.
2	Turn the power OFF, and check the connection of the detector cables (between driver and I/F units) with a tester.	There is a connection fault.	Replace the communication cable.
		The connection is normal.	Investigate item 3.
3	Connect with another normal axis unit and check whether the fault is on the unit side or MDS-B-HR side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the MDS-B-HR side.	Investigate item 4.
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace MDS-B-HR.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 85	HR unit data error: An error was detected in the analog interpolation data of the MDS-B-HR connected to the MAIN side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "80" items.		

Alarm No. 86	HR unit pole error: An error was detected in the pole data of the MDS-B-HR connected to the MAIN side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Wiggle the connectors by hand to check whether the MDS-B-HR connectors (unit side, HR side and MD side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 2.
2	Turn the power OFF, and check the connection of the detector cables (between driver and I/F units and between I/F unit and pole detector) with a tester.	There is a connection fault.	Replace the communication cable.
		The connection is normal.	Investigate item 3.
3	Connect with another normal axis unit (or MDS-B-HR) and check whether the fault is on the unit side or MDS-B-HR (MDS-B-MD) side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the MDS-B-HR (MDS-B-MD) side.	Investigate item 4.
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace MDS-B-HR (MDS-B-MD).
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding …. Additionally ground.

Alarm No. 88	Watch dog: The servo drive software processing time did not end within the specified time.	Alarm check timing			
		f1	f2	f3	f4
		○	○	○	○

	Investigation details	Investigation results	Remedies
1	Check whether the servo software version has been changed recently.	The version was changed.	Replace with the original software version.
		The version was not changed.	Investigate item 2.
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding .... Additionally ground.

Alarm No. 89	HR unit connection error (SUB): An incorrect connection or cable breakage was detected in the MDS-B-HR connected to the SUB side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "80" items.		

⚠ CAUTION

To prevent trouble, when changing the motor and driver combination, avoid driving a driver with a larger capacity than the specified driver using the motor. The motor could be demagnetized. Note that this combination can be used for checking in the emergency stop state. The motor can be driven with a driver with a capacity smaller than the specifications.

Alarm No. 8A	HR unit HSS communication error (SUB): The MDS-B-HR connected to the SUB side detected an error in the communication with the absolute position linear scale.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "80" items.		

Alarm No. 8C	HR unit scale judgment error (SUB): The MDS-B-HR connected to the SUB side could not judge the analog frequency of the connected linear scale.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "83" items.		

Alarm No. 8D	HR unit CPU error (SUB): The CPU of the MDS-B-HR connected to the SUB side is not operating correctly.	Alarm check timing			
		f1	f2	f3	f4
		○	–	–	–

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "84" items.		

Alarm No. 8E	HR unit data error (SUB): An error was detected in the analog interpolation data of the MDS-B-HR connected to the SUB side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "80" items.		

Alarm No. 8F	HR unit pole error (SUB): An error was detected in the pole data of the MDS-B-HR connected to the SUB side.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "86" items.		

Alarm No. 93	Absolute position fluctuation: A fluctuation exceeding the tolerable value was detected in the absolute position detected when the CNC power is turned ON.	Alarm check timing			
		f1	f2	f3	f4
		–	○	–	–

	Investigation details	Investigation results	Remedies
1	Wiggle the connectors by hand to check whether the detector connectors (unit side and detector side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 2.
2	Turn the power OFF, and check the connection of the detector cables with a tester.	There is a connection fault.	Replace the communication cable.
		The connection is normal.	Investigate item 3.
3	Check the repeatability. Carry out zero point return again.	The alarm is not repeated.	If no abnormality is found with investigation item 5, continue use.
		The alarm is always repeated. Or, the state returns to normal once, but then is repeated sometimes.	Investigate item 4.
4	Connect with another normal axis unit and check whether the fault is on the unit side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm occurs even when the unit is replaced.	Investigate item 5.
5	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the motor (detector).
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding .... Additionally ground.

⚠ CAUTION

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Alarm No. 9B	Pole shift warning: An error was detected in the pole shift amount set in servo parameter SV028.	Alarm check timing			
		f1	f2	f3	f4
		–	–	○	–

	Investigation details	Investigation results	Remedies
1	Check whether the MDS-B-MD system is being used.	The system is not MDS-B-MD.	Investigate item 4.
		The system is MDS-B-MD.	Investigate item 2.
2	Check whether the warning occurred at the first movement after setting the servo parameter (SV028).	Movement is possible several times without a warning.	Investigate item 4.
		The warning occurred at the first movement.	Investigate item 3.
3	Carry out DC excitation again, and check the servo parameter (SV028) setting value.	The SV028 setting value is the same with the previous and current DC excitation.	Investigate item 4.
		The SV028 setting value is different with the previous and current DC excitation.	Set SV028 to the current DC excitation value. ↓ If the problem is not resolved, check investigation item 4.
4	Wiggle the connectors by hand to check whether the MDS-B-HR connectors (unit side, HR side and MD side) are disconnected.	The connector is disconnected (or loose).	Correctly install.
		The connector is not disconnected.	Investigate item 5.
5	Turn the power OFF, and check the connection of the detector cables (between driver I/F units and between I/F unit and pole detector) with a tester.	There is a connection fault.	Replace the communication cable.
		The connection is normal.	Investigate item 6.
6	Connect with another normal axis unit (or MDS-B-HR) and check whether the fault is on the unit side or MDS-B-HR (MDS-B-MD) side.	The alarm is on the unit side.	Replace the drive unit.
		The alarm is on the MDS-B-HR (MDS-B-MD) side.	Investigate item 7.
7	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace MDS-B-HR (linear scale or MDS-B-MD).
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature ... Check the cooling fan. Incomplete grounding .... Additionally ground.

Alarm No. 9C	HR unit pole warning: An error was detected in the pole position data of the MDS-B-HR connected to the MAIN side after passing the Z phase.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "86" items.		

Alarm No. 9D	HR unit pole warning (SUB): An error was detected in the pole position data of the MDS-B-HR connected to the SUB side after passing the Z phase.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check the alarm No. "86" items.		

Alarm No. E1	Overload warning: An level 80% of the overload alarm 1 was detected.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check whether the motor is hot.	The motor is not hot.	Check the alarm No. "50" items.
		The motor is hot.	Investigate item 2.
2	Check whether there is a problem during acceleration/deceleration operation.	Operation is possible without problem.	1. If possible, ease the operation pattern. 2. If an alarm does not occur with continued operation, continue in this state.
		There is a problem in the operation.	Check investigation items 3 and following of alarm No. "50".

Alarm No. E4	Parameter error warning: A parameter exceeding the setting range was set.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	–

	Investigation details	Investigation results	Remedies
1	Set the correct values following the parameter adjustment procedures.		

Alarm No. E7	CNC emergency stop: An emergency stop signal is being sent from the CNC, or an alarm is occurring in another axis.	Alarm check timing			
		f1	f2	f3	f4
		–	○	○	○

	Investigation details	Investigation results	Remedies
1	Check whether the CNC side emergency stop switch has been applied.	The emergency stop state is entered.	Investigate item 2.
		Emergency stop has been canceled.	Investigate item 3.
2	Cancel the emergency stop.	Operation starts normally.	Normal
		"E7" remains displayed.	Investigate item 3.
3	Check whether the terminator or battery unit is connected, or whether these are loose.	Pinpoint the cause of the fault.	Correct the fault.
		Normal	Check the alarm No. "34" items.

⚠ CAUTION

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